THE ROLE OF DESIGN GUIDELINES

FOR ACCIDENT AND EMERGENCY FACILITIES

IN SOUTH AFRICA

By

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Dedication

To my firm, Ngonyama Okpanum and Associates, which has given me the opportunity to conduct this research. And to Chris Hani Baragwanath Hospital, Soweto, Johannesburg and Pretoria Academic Hospital, Pretoria, South Africa where the researcher learned many practical lessons, and obtained the knowledge and information used in this research.

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To my father; Godfrey, and my mother; Victoria, for their caring, love, hard work, and dedication; and the meaning they brought into my life. And to Carol, Sarah and Ike for their sweet care, love and compassion in the most critical moments of my study.

Declaration

This dissertation is based on an original research study
and in full acknowledgment of all sources on the information system used.

Abstract

This study is focused on design guidelines (DGs) for healthcare facilities development in South Africa which date to the apartheid era, the consequence of which is inadequate provision of healthcare facilities in urban areas where the poor black majority live and work. It aims to assess the role of DGs in the development and provision of healthcare facilities; and more specifically to assess the role of design guidelines for accident and emergency facilities (DGAEF) so as to make recommendations on how to improve their design and project development process. Informed and guided by philosophical and theoretical frameworks and a conceptual model of DGAEF, the empirical research was conducted between 2006 and 2007 using the following methodologies: questionnaire and interview surveys, floor plan analyses and observational studies. Owing to geographical, financial and time constraints, the study was restricted to two case study accident and emergency (A&E) facilities—Chris Hani Baragwanath Hospital (CHBH) in Soweto, Johannesburg and Pretoria Academic Hospital in Pretoria. The information gathered was analysed using descriptive statistics, content analysis, Space Syntax analysis, hierarchical task analysis and link analysis. A SWOT (Strength-Weaknesses-Opportunities-Threats) analysis was also conducted.

The main findings are that there is inadequate policy attention to DGAEF update; lack of integration of the project brief, design and construction processes; excessive timeframes for project development; quality issues; and lack of post-occupancy evaluation (POE). Thus, the findings underscore the need to develop and introduce design quality indicators (DQIs) and key performance indicators (KPIs) in the general and specific design requirements in the DGAEF used for space design and provision, functional suitability and spatial relationships.

The key recommendation of this research is that, to improve access to adequate A&E facilities and achieve measurable positive outcomes in healthcare services delivery in South Africa, the DGAEF should be updated based on evidence. To this end, research-based guiding principles, based on Planetree principles, are presented—which emphasise improved project communication approaches; understanding of value systems; participatory design processes; constant use and update of information systems through technology innovation; standardisation of the overall project development process from briefing through to POE; and institutional transformation based on societal change.

Acknowledgement

This research grew out of twelve years of study, design and practical experience of the researcher in healthcare facilities project development processes in various countries, including South Africa, Nigeria, Italy, UK, USA and Canada. The universe of people who provide a support network for this kind of research goes far beyond those directly involved in the supervision, research assistance and organisational aspects and reviewing. Thus, over the past five years, the researcher has had the privilege and pleasure of interacting with many members of the academic and research community, professionals, government officials, caregivers, patients and community members; most of whom have contributed valuably to this study in one way or another.

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List of abbreviations

A&E	Accident and Emergency
ACEP	American College of Emergency Physician
AEDET	Achieving Excellence Design Evaluation Toolkit
AIAH	American Institute of Architects for Health
ANC	African National Conference
BEE	Black Economic Empowerment
BIM	Building Information Modelling
CAD	Computer aided design
CHBH	Chris Hani Baragwanath Hospital
COSATU	Congress of South African Trade Union
CW	Casualty Ward
DF	Domain of Functions
DG	Design Guidelines
DGAEF	Design Guidelines for Accident and Emergency Facilities
DHSS	Department of Health and Social Services
DPSCS	Domain of Procurements and Construction Systems
DQIs	Design Quality Indicators
DSR	Domain of Statutory Requirements
DTP	Domain of Technical Performance
ED	Emergency Department
ER	Emergency Room
FDI	Foreign Direct Investment
GEAR	Growth, Employment and Redistribution
GNP	Gross National Product
HAI	Hospital Acquired Infection
HBN	Health Building Notes
HTA	Hierarchical Task Analysis
IOS	International Organisation for Standardisation
KPIs	Key Performance Indicators
L1	Level 1
L2	Level 2
L3	Level 3
LA	Link Analysis

MRSA	Methicillin-Resistant Staphylococcus Aureus
NHS	National Health Services
NPC	National Planning Commission
NPS	National Planning Secretariat
P1	Priority 1
P2	Priority 2
P3	Priority 3
P4	Priority 4
PAH	Pretoria Academic Hospital
PC	Project Commissioning
PCD	Primary Care Department
PDP	Project Development Process
PFI	Private Finance Initiative
PHC	Primary Healthcare
POE	Post Occupancy Evaluation
PPP	Public Private Partnership
PU	Planning Unit
RDP	Reconstruction and Development Programme
SACP	South African Communist Party
SAHNORMS	South African Hospital Norms
SMME	Small Medium Micro Enterprises
SWOT	Strengths, Weaknesses, Opportunities and Threats
VGA	Visibility Graph Analysis
WHO	World Health Organisation

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1 CHAPTER ONE

BACKGROUND TO THE STUDY

1.1 Introduction

The Right to Health for all is recognized in the Universal Declaration of Human Rights and in several international human rights instruments, covenants and consensus documents. A majority of state governments have committed themselves, to varying degrees, to implement the Right to Health, including the right to access health facilities, goods and services. Many national constitutions, including that of South Africa, also recognise the Right to Health and mention the obligation of the state to provide healthcare and public health services.

General Comment No. 14 of the Committee on Economic, Social and Cultural Rights (CESCR), adopted in the year 2000, elaborates on and clarifies the Right to Health by defining the content, the methods of operationalisation, the violations and the suggested means to monitor the implementation of this right. These include:

> "ensur[ing]….the provision of a sufficient number of hospitals, clinics and other health-related facilities,….with due regard to equitable distribution throughout the country."

This study aims to assess the role of design guidelines (DGs) in the development and provision of healthcare facilities; and more specifically to assess the role of design guidelines for accident and emergency facilities (DGAEF) in South Africa so as to make recommendations on how to improve their design and project development process. The basic assumption of the study is that the update of the DGAEF can improve the design of accident and emergency (A&E) facilities, which is essential to the achievement of the right to healthcare services as provided for in the South African Constitution.

1.1.1 Healthcare services delivery

The World Health Organisation (WHO) defines a health system as "all the activities whose primary purpose is to promote, restore, or maintain health" (WHO, 2000:5). A health system includes the institutions, actors and resources related to the provision, financing and regulation of health actions; whereby a health action is defined as "any set of activities whose primary intent is to improve or maintain health for all" (Murray and Frenk, 1999:4).

WHO activities aimed at improving healthcare services delivery can be summarily categorised as follows (Kleczkowski and Pibouleau, 1976):

(1) actions aimed at increased population coverage;

(2) actions aimed at improved quality and utilization of services;

(3) actions aimed at increased efficiency and less costly services;

(4) actions aimed at better planning and allocation of resources.

The South African government's Department of Health's vision is in line with above: "An accessible, caring and high quality health system" (Department of Health, 2010:10); and to achieve this vision its mission is:

> "To improve health status through the prevention of illnesses and the promotion of healthy lifestyles and to consistently improve the [healthcare] delivery system by focusing on access, equity, efficiency, quality and sustainability" (Department of Health, 2010:10).

The success of healthcare systems, policies and programmes is dependent on the provision of adequate healthcare facilities, as confirmed by studies by Akinboade et al. (2009), Bloom and Canning (2003), Bloom et al. (2004), Bradshaw and Mbodo (1995), Heunis (2004), Ntsaluba and Pillay (1998), Schneider et al. (2007), and Verderber and Fine (2000).

1.1.2 Healthcare facilities project development process

Healthcare involves the provision of care and support to well being through treatment, prevention and education. The healthcare delivery process is constantly changing owing to multiple forces that range from medical, service and technological innovations to socio-political influences. In this context, the importance of appropriate[1] facilities in the delivery of healthcare services is well recognised (Codinhoto et al., 2008b; Tzortzopoulos et al., 2008).

Healthcare facilities, as explained by (Tzortzopoulos et al., 2009:47):

[1] Appropriateness, as defined by Tzortzopoulos et al. (2008), here refers to the availability of good quality buildings, their geographic location and the mix of services provided in relation to the specific population needs both current and predicted.

> "are designed to achieve diverse objectives, ranging from providing appropriate environments where care can be delivered to communities to increasing operational efficiency and improving patient flows and the patient experience. Improvements in efficiency should result from state-of-the-art buildings, more appropriate layouts, departmental adjacencies, efficient clinical and business processes and enhanced information systems."

The healthcare facilities project development process involves a number of individual but interrelated components and phases, which play an important part in minimizing risk and maximizing efficiencies, and technical and economic robustness of designs and decisions. They include feasibility study, project brief, schematic design phase, design development phase, contract document phase, procurement, contract award, construction phase and pre-commissioning phase (Nah and Osifo-Dawodu, 2007).

The healthcare facility project development process offers a rare opportunity for healthcare organizations to "rethink" their current patient care delivery model, organisational culture and the use of technology. Indeed, as Hayward (2006b:1) asserts,

> "[a] major financial investment in A&E facilities should result in enhanced healthcare services delivery, improved operational efficiency, increased flexibility and code-compliant building"

Healthcare facilities development, as observed by Lindheim (1985), is now increasingly based on Planetree principles which focus on a patient/caregiver/family-centred design approach. Frampton et al. (2003) affirm that DGs can be used to explore and develop vital aspects of healthcare facilities based on the new design paradigm which focuses on: natural environment; built environment; social environment and symbolic environment.

The healthcare facility project development process and Planetree philosophy and principles are discussed in more detail in Chapter Two.

1.1.3 Design guidelines for A&E facilities

Design guidelines (DGs) are aimed at directing project planning, design and implementation. They provide a framework of "principles, directions and guidance in the steps from goal-to-programme-to-design" (Hsia, 1988:305); and basically take the form of (i) behavioural or attitudinal statements; (ii) performance standards; or (iii) prescriptive guidelines. In other words, they may be classified as prescriptive- or performance-based

(Hsia, 1988). They may be issued and used by any organisation, government or private, to influence decision-making—presumably in a standardised predictable manner so as to obtain a higher quality, effective and efficient product (Valins and Salter, 1996); especially in a context of limited resources and competing priorities.

Indeed, the driving forces behind the development and introduction of DGs in South Africa for healthcare facilities were a reduction in available finance following the oil crisis of the 1970s and the escalating cost of healthcare facilities.[2] These factors led most countries, both developed and developing, to a recognition of the need to rationalise expenditure on healthcare facilities development by, among other things, limiting the size of healthcare buildings and more accurately predicting final construction costs (Abbott and Cowan, 1989).

1.1.4 Design guidelines for A&E facilities in South Africa: an introductory overview

The above reasons led to the introduction of DGs for healthcare facilities in South Africa in 1970. This was through the appointment of a committee, led by T.L. Webb, to investigate the concept of area and cost norms; and propose guidelines for project briefing, design, construction and commissioning of healthcare facilities in South Africa (Abbott and Cowan, 1989).

The Webb Committee's terms of reference were to prepare minimum acceptable standards for the design, construction and equipping of general and academic healthcare facilities; but in applying their terms of reference, the committee interpreted this to mean "an overall maximum area per planning unit". Hence, the use of a theoretical healthcare facility model linked to maximum area per planning unit with elemental cost analysis developed as the basis of the South African design guidelines (Abbott and Cowan, 1989).

In developing the area norms, the Webb Committee conducted studies of existing local and overseas healthcare facilities, in particular in the United Kingdom (UK), Canada and

[2] The latter was perhaps owing to the cost disparity between the USD 1 million estimate for Tygerberg Hospital and its final cost of well over USD 20 million (Abbott and Cowan, 1989).

Australia. The studies mainly covered information on clinical areas, such as examination, treatment, and resuscitation areas; and excluded, support areas like admissions, patient waiting, caregivers and other ancillary areas. The studies established an acceptable area range with a maximum limit beyond which expenditure would be needless and wasteful; and a minimum limit below which adequate healthcare service delivery could not be provided efficiently and effectively (Abbott and Cowan, 1989).

The Webb Committee addressed these needs in 1975, and recommended the following:

- area norms for appropriate planning units for various departments of general hospitals;
- cost norms expressed in Rand per unit area for each planning unit;
- costs of loose equipment to enable commissioning of healthcare buildings;
- guidelines for air conditioning;
- guidelines on the size for healthcare buildings;
- cost controls in respect of planning, design, programming and construction of healthcare facilities buildings.

This approach resulted in dropping the minimum limit in the amended and approved Webb Report, which was transformed into DGs for healthcare facilities—South African Hospital Norms (SAHNorms)—by the National Department of Health in June 1981. Hence, SAHNorms only provide guidance on the maximum area for A&E facilities. Table 1.1 summarises the revised (October 1987) DGs for calculating planning units for A&E facilities. A complete summary of the SAHNorms is included in Appendix B.

Table 1.1: Summary of revised (October 1987) DGAEF for the estimation of the planning units

A&E facility	Planning units (PU)	Space needs	Area based on DGs	Cost norm December 1979
• Emergency	• Patients in 3 hour peak period	• Determine likely number of emergency patients in a 3-hour peak period • Use outpatient design guidance where the number of patients is less than 60 during a 3-hour period	• 430 m^2/60 patients plus 100 m^2 for every additional 50 patients	• R 378/m2

The DGAEF provide an area linked to a 3-hour peak number of patients, which is 430 m^2 for the first 50 patients and 100 m^2 for every additional 50 patients. They also recommend the provision of one treatment area for 1,100 attendees or one treatment area for 400 yearly admissions, and also one resuscitation area for every 15,000 yearly admissions.

The DGs for healthcare facilities in South Africa are viewed in different ways by those involved in healthcare facility planning and design. For example,

> "[the healthcare] facility planner might see design guidelines as a means of controlling capital expenditure, or perhaps a means of limiting the overall size of a building...the designer or planner might see them as a requirement for approval. While for the healthcare facility designer, they might convey...an image of unnecessary and unwanted bureaucratic control" (Abbott and Cowan, 1989)

1.1.5 The context of the study: South Africa

South Africa, the southernmost country on the African continent, is divided into nine provinces, as shown in Figure 1.1. The smallest by far, geographically, is Gauteng; but it is also the economic hub of the country, with the highest per capita income (Davenport, 1991).

Figure 1.1: Map of South Africa

Any developments in Gauteng province, including those in the health sector, have major strategic significance for South Africa and beyond (Beinart and Dubow, 1995; Vail, 1989). Of particular relevance to this research is the emphasis that Gauteng lays on the delivery of healthcare services that are accessible, equitable, efficient, effective and sustainable; and provide a high quality of care.

The Gauteng Department of Health's vision of *Health for a Better Life* aims to improve health status and life expectancy of residents. This vision sees health as an investment in human resources that is interrelated to sustainable socio-economic growth. The public health system serves the vast majority of people, with over nine million visits made annually to primary health care facilities, in particular A&E facilities (Gauteng Provincial Department of Health, 2009).

The case studies for this research are the A&E facilities at two major hospitals in Gauteng Province, South Africa—Chris Hani Baragwanath Hospital **(**CHBH), Soweto, Johannesburg and Pretoria Academic Hospital (PAH), Pretoria.

1.2 Statement of the problem

> "Mortality from trauma and injury in urban areas in South Africa is among the highest in the world, making accident and emergency services all the more vital" (Clarke, 1998:368).

The history of South Africa has profoundly influenced the national health policy, the healthcare system, healthcare services delivery and healthcare facilities development of the present day. The apartheid policies of the Nationalist government (1948–1994) created a dysfunctional healthcare system which was upheld by the promulgation of racist legislation and the creation of institutions, such as political and statutory bodies for the control and development of healthcare facilities, specifically aimed at perpetuating racial segregation and discrimination in healthcare. In addition, the migrant labour system, vast income inequalities, and extreme violence have all formed part of the country's lamentable past; and all have inexorably affected health and healthcare services delivery (Coovadia et al., 2009).

> "The net result has been a system which is highly fragmented, biased towards curative care and the private sector, inefficient and inequitable" (ANC, 1994a:1).

In 1994, when apartheid ended and the first democratically elected government came into power, the healthcare system faced massive challenges, many of which still persist. In particular, public sector capacity for policy implementation has proved to be inadequate. Consequently, despite a significant increase in government spending on healthcare since 1995, there has not been a reduction in the healthcare facilities backlog. The latter is partly attributable to the continued use of obsolete and inappropriate DGs developed by the apartheid government.

Since 1994, there have been significant changes in healthcare systems policies and healthcare facilities project development processes, owing to changes in socioeconomic, cultural and political circumstances in South Africa. However, these are not adequately reflected in DGs (Francis et al., 2001; Hamilton and Orr, 2006). As Okpanum (2002) observes, there is no integrated approach between healthcare systems policies and the DGs used for healthcare facilities projects.

Although the country is working toward the goal of equity, efficiency, effectiveness and responsiveness of the healthcare system, many challenges remain. Indeed, equalizing access to A&E facilities for all citizens is especially challenging owing to disparities in infrastructure and resources between regions, and even within the same province. Hence, emergency care has been identified as a priority; and although not considered primary care, it is deemed to be integral to a comprehensive health care system; a main reason being that adequate A&E facilities have been lacking in many disadvantaged areas (Clarke, 1998).

Delays in A&E facilities development, which are adding to the pressure on existing and functioning ones and constraining efficient and effective healthcare services delivery to the community, can be largely attributed to problems in the application of the DGAEF (Purves, 2009; Schneider et al., 2007). The apparent inadequacies in DGAEF are arguably attributable to little interest in their continuous update; as well as the absence of user-led research.

Thus, the aim of this study is *to assess the role of design guidelines for A&E facilities in South Africa so as to make recommendations on how to improve their design and project development process*.

1.3 Research aim, objectives and contributions

The aim of this research is *to assess the role of design guidelines for accident and emergency (A&E) facilities in South Africa so as to make recommendations on how to improve their design and project development process.* To achieve this aim, the study is guided by the objectives summarised in Table 1.2.

Table 1.2: Research aim, objectives and contributions

Research aim: To assess the role of design guidelines for A&E facilities in South Africa so as to make recommendations on how to improve their design and project development process.

Research objectives	Research contributions
1. To critically assess the role of DGs in healthcare services delivery process and identify challenges and obstacles to quality healthcare services provision	1. An improved understanding of the role of DGAEF in the design of efficient, effective and responsive A&E facilities in South Africa
2. To investigate the role of the DGs in the delivery of A&E facilities in South Africa	
3. To investigate the influence of DGs on the interdisciplinary project team and users in design, construction and operational processes of A&E facilities	2. Highlighting the importance of connecting practice to research (and back to practice) to healthcare facility planning and design professionals, and in particular, healthcare architecture professionals.
4. To assess the role of the DGs on the design, construction and operations innovation of A&E facilities in South Africa	3. Guiding principles for DGAEF update for effective and efficient A&E facilities in South Africa
5. To explore the role of the DGs on organisational processes in the exiting A&E facilities	
6. To develop research based recommendations (guiding principles) for the design of A&E facilities in South Africa	

1.4 Research questions

Robust research questions determine and guide the research process, helping the researcher decide on the data required and how best to collect it (Abbott and Cowan, 1989; Creswell, 1998; Stake, 1995; 2005). Thus, researchers generally direct emphasis on defined and focused research questions. But while it is important to know what one is looking for, this initial focus should not divert attention from other unanticipated questions which are perhaps more interesting, important or manageable than the initial one(s) (De Vaus, 2002).

The research questions listed in Table 1.3 were thus formulated to address the overall aim and specific objectives of the research, and to guide the empirical research process. The research questions were developed through the following processes: a review of the literature on DGAEF; meetings with government officials, caregivers, healthcare facility planning and design professionals; discussions with subject specialists; exploratory studies of similar healthcare facilities elsewhere in South Africa; and practice-based experience of the researcher. The latter includes post occupancy evaluation (POE) studies by the researcher of A&E facilities in South Africa (Okpanum, 2002; 2003; 2004). The research questions were continually reviewed throughout the research process to ensure that the aim and objectives of the study were adhered to.[3]

Table 1.3: Primary and supporting research questions

1. Are DGAEF followed?	
1.1 Why are DGAEF important?	1.4 To what extent do DGAEF influence project development process and programme?
1.2 How can DGAEF improve project briefing documents?	1.5 What are the effects of DGAEF on project budgets?
1.3 Can design development and documentation process be simplified?	
2. How effective and efficient are healthcare services delivered from A&E facilities?	
2.1 Can the opinion of the stakeholders influence the DGAEF update?	2.4 What are the obstacles constraining the use of technological innovations and updates for healthcare facility design and operations?
2.2 How can physical environment influence the quality of healthcare services delivery?	2.5 How can DGAEF update influence the use of interdisciplinary design team for the project development processes?
2.3 Can a patient/caregivers/family centred design approach influence the quality of healthcare services delivery?	
3. What are the contributions of buildings towards effective and efficient A&E operations?	
3.1 Are the users satisfied with the design quality of the A&E facility?	3.4 What are the effects of DGAEF update on flexibility and adaptability of the space provision?
3.2 How can the physical environment improve A&E facility capacity efficiency?	3.5 How can DGAEF update improve durability and serviceability of the space provision?
3.3 Can DGAEF update improve standardisation of project development and operational processes?	

1.5 Research strategy

A fundamental part of any research process is the decisions underpinning it (Merriam, 2002). The decision to undertake this study was taken in 2001, when the researcher was involved in the design of the CHBH A&E facility. This research is thus motivated by real life observation of the project design and development process of the CHBH A&E facility; as

[3] See Appendices C, D, E, F, G and H.

well as other POE studies of A&E facilities in South Africa by the researcher (Okpanum, 2002; 2003; 2004).

Inquiry paradigms are fundamental to decisions with regard to the research design and methodology. In this regard, research methods and techniques in healthcare architecture have been evolving over the past several decades owing to dramatic social, technological and architectural transformation of healthcare facilities project development processes (Wagenaar et al., 2006). For example, since the 1960s and 1970s, technology innovation[4] has significantly influenced research methods used in developing DGs for in-patient facilities (Miller and Swensson, 2002). However, one of the most important conceptual developments is the notion that the hospital environment can contribute to human health and well-being, which is considered to be the philosophical root of the development of evidence-based design research in healthcare architecture. In a relatively short time, evidence-based design research has impacted significantly on the thinking of healthcare design professionals and others involved in the planning and design of healthcare environments (Codinhoto et al., 2010; Lawson and Phiri, 2003; Malkin, 2002b; Rubin et al., 1998; Ulirich, 1984; 1986).

Careful analysis of the research problem and primary and supporting research questions revealed that they are in “why”, “what” and “how” forms. In addition, from the review of the literature, the feedback from the exploratory studies, and Silverman’s (2005) recommendations, it was clear that a mixed-methods approach, combining quantitative and qualitative methods, was the most appropriate strategy for the study on DGAEF update (see Chapter Four). This approach has been used in healthcare facilities studies by several researchers (Beaver et al., 1991; Farrow and VanderKaay, 2009; Hignett and Evans, 2006; Lu and Hignett, 2007). Thus, in line with (Kao et al., 2009:1008),

> “The adopted approach sought to occupy the middle ground between inductive and deductive case study research whereby emergent findings are interrogated against...theoretical models derived from the literature.”

[4] For purposes of this study, technology innovation is defined as *an improvement to something already existing and source of increased efficiency and effectiveness for all types of productive and communicative systems achieved through scientific and technical progress* (Bijker, t al., 1989). Technology innovation in relation to DGs used for healthcare facilities development may have enormous socioeconomic importance as it can be a source for stimulating increased cultural, social and economic participation.

1.6 Research process

Research, as defined by Patton (2002:32), is "a systemic process of enquiry whose goal is communicable knowledge". Indeed, as Yin (2003:21) affirms:

> "Unless research activity has been carefully planned, data analysis made through established protocols and an effort to disseminate knowledge [made]...it cannot be classed as "research".

Reflecting on the above definition, the research process was planned and structured into six continuous, interlinked and progressive stages as follows:

1. The initial stage involved the identification and formulation of the research problem and questions; and a justification for this study. It included a critical exploratory assessment of the role of DGAEF. This stage is detailed in this first chapter.
2. The second stage, the review of the literature and research context, focused on analysing current knowledge on the topic and identifying gaps therein; approaches to the interpretation, translation and application of DGAEF; and institutional, organisational and operational issues relating to DGAEF, particularly within the context of South Africa. This stage established the philosophical, theoretical and methodological framework for the study, and is presented in Chapters Two and Three.
3. The third stage was linked to the outcome of the second stage and entailed the design and development of the empirical research strategy, including data collection and analysis procedures. Chapter Four explains this stage more fully.
4. The fourth stage was the fieldwork using mixed-methods data collection strategies, including questionnaire and interview surveys, floor plan analysis and observational studies. This stage is also detailed in Chapter Four.
5. The fifth stage included the processing, analysis and interpretation of the data using mixed-method approaches. This stage is presented in Chapters Five, Six and Seven.
6. The last stage summarised and reviewed the research findings, including synthesising the philosophical and theoretical perspectives and empirical findings, drawing conclusions; and formulating recommendations/guiding principles. The limitations and

gaps were also identified, and suggestions for further research put forward. Summary details of this stage are presented in Chapters Eight and Nine.

1.7 Scope and limitations of the study

The overall aim of this research is to improve the design of A&E facilities. The main focus of the study is thus to explore, understand and produce new knowledge for the update of the DGAEF through, *inter alia,* identifying the major challenges and barriers limiting compliance by key stakeholders. The study is therefore limited to the themes identified, through the literature review, as gaps, challenges and obstacles to compliance to the DGAEF, which are: design tools; quality of the physical environment; and perception or impact.

In addition, owing to geographical, technical, time, and human and financial resource limitations, the study is focused on only two case study A&E facilities in Gauteng Province. The study was further limited by the difficulty obtaining permission for photographic documentation owing to the nature of the operations in A&E environment; in addition to the very little information in the literature on DGAEF. The limitations on the research are discussed in detail in Chapters Four and Nine (see 4.8 and 9.5).

1.8 Justification and significance of the research

The very little information in the literature on DGAEF, especially with particular reference to South Africa and other developing countries, justifies this research. The significance of this study is both theoretical and practical: DGAEF are now better investigated, understood and new knowledge generated to improve guidance for A&E facilities project development processes. The research findings and recommendations will be of interest to broad range of stakeholders. Further reasons why the study is justified and significant are summarised in Table 1.4.

Table 1.4: Justification and significance of the research

1. The study addresses gaps in the literature on DGAEF with respect to their interpretation, translation and application; and the efficiency and effectiveness of A&E facilities project development processes
2. The study provides new insights into A&E facilities development, thereby facilitating more effective and efficient project development processes in future. The findings provide an empirical basis for addressing major constraints to the achievement of the healthcare system policy objectives of equity; efficiency; effectiveness and responsiveness.
3. The research methodology can be used for similar studies on DGAEF in other provinces of South Africa and in other developing countries with similar contextual backgrounds, while the data and information gathered through this study can be utilised for future research.
4. The study underscores the need to develop and introduce key performance indicators (KPIs) and the concept of "design and operational systems-based perspectives" in the DGAEF to improve integration between people, space, processes and technology. The new concept is targeted at specific goals that will be applied consistently across the project development process to ensure integrated coordination of operational systems in A&E facilities.
5. This study could open a new area in research concerning DGs for healthcare facilities development using the concepts of interdisciplinary project team and integrated project development process.

1.9 Structure of the thesis

The organisation of the study, which is described in detail in section 1.2.4, is summarised in Table 1.5 below.

Table 1.5: Structure of the thesis

Chapter One:	Introduces the background to the study; the challenges facing the development of A&E facilities in South Africa; and the DGAEF. An introductory overview of the role of DGAEF is presented. The research problem, aim and objectives of the research, and the research questions are also stated.
Chapter Two:	Presents a critical analysis of the interpretation, translation and application of the DGs; and the philosophical, theoretical and conceptual framework for DGs update based on the literature review.
Chapter Three:	Describes the context of the study, including the geographical and socio-econo-political landscape. Information on the South African healthcare system and the evolution of A&E facilities is also provided.
Chapter Four:	Introduces the research methodology, empirical research process, and the data collection and analysis procedures and tools.
Chapter Five	Presents the analysis and results of the questionnaire surveys.
Chapter Six:	Reports the empirical findings on the influence of the use of the DGAEF for the overall project development of CHBH A&E facility.
Chapter Seven:	Reports the empirical findings on the influence of the use of the DGAEF for the overall project development of PAH A&E facility.
Chapter Eight:	Discusses the theoretical and empirical findings of the study concerning the importance of the DGAEF for the improvement of the design of A&E facilities.
Chapter Nine	Draws conclusions and presents recommendations (guiding principles). It also discusses the implications and limitations of the study, and puts forward suggestions for further research.

2 CHAPTER TWO

DESIGN OF HEALTHCARE FACILITIES

2.1 Introduction

This chapter develops the philosophical and theoretical framework for the study. It `defines and discusses the key dimensions and sub-dimensions of the DGAEF; their interpretation, translation and application; and an alternative approach to their update.

The chapter comprises fourteen sections. Following this introduction, sections two and three overview the healthcare services delivery process and healthcare facilities project development process; while sections four and five overview the DGs and their domains. Theories in the history of DGs for healthcare facilities and the Planetree philosophy are presented in sections seven, while the following two sections analyse the structure of the DGs and the structure of DGs based on Planetree principles. Sections ten and eleven explain the influence of DGs on the project development process; and the gaps and limitations in the DGs. The philosophical and theoretical framework for DGs update; the emerging themes from the literature review; and the proposed conceptual framework for DGs update are articulated in the following three sections. The chapter ends with a summary and concluding remarks.

2.2 Healthcare services delivery process

The process through which healthcare services are delivered has evolved significantly over time—from the care exercised in the mercy temples of the early civilisations, to the current continuous advancement of the scientific approach to healthcare services delivery (Verderber and Fine, 2000). The healthcare delivery process has been subject to change due to myriad forces ranging from medical and technological innovations to socio-economic and political influences. The healthcare services delivery process has thus evolved into an ambitious operational system using large, technologically advanced healthcare facilities, as explained more fully below. This, however, has also resulted in failure to deliver services punctually and within budget, giving rise to wide-ranging reviews of the healthcare services delivery process (Clark, 2008; Miller and Swensson, 2002). In this context, the importance of appropriate buildings and facilities in which healthcare can be delivered has been widely recognised (Codinhoto et al., 2008b; Tzortzopoulos et al., 2009).

2.3 Healthcare facilities project development process

Healthcare buildings and facilities are intended to achieve multiple objectives, ranging from providing appropriate environments where care can be effectively delivered to increasing operational efficiency and improving patient flows and the patient experience. These can be achieved through, inter alia, state of-the-art buildings, more appropriate layouts, departmental adjacencies, efficient operational processes and enhanced information systems (Tzortzopoulos et al., 2008).

Current government expenditure on public healthcare facilities is, however, not only inadequate, but also ineffectively used during healthcare facilities project development processes (Filmer and Pritchett, 1999). Hence the recent focus on government under-spending on healthcare projects aimed at the poor (Whelan, 2000). Indeed,

> "[l]ack of spending on the construction and maintenance of healthcare facilities has profound implications for disadvantaged communities who rely on the public health service to preserve one of their most important assets, the ability to work"(Van Rensburg, 2004:6).

However, as Bloom et al. (2004) caution, improvements in the healthcare system may be difficult to achieve without mutual understanding and cooperation between stakeholders.

The Center for Health Design (2009) argues for the provision of information systems in the DGs that will integrate the project development process through the appointment of an interdisciplinary project team addressing the full range of issues relating to project briefing, design, construction, commissioning, operation, maintenance and POE. The appointment of the interdisciplinary project team at the front-end of the design process for healthcare facilities—"the preliminary, pre-project stages of the design and construction process" (Tzortzopoulos et al., 2006:660)—is essential to ensure that all stakeholders share the same project vision and goals (Okpanum, 2009). Table 2.1 shows the potential team participants.

Table 2.1: Interdisciplinary project team participants

Owners	Users	Consultants	Researchers
• Government • Board members • Chief executive officer • Chief financial officer • Chief of staff • Medical director • Key managers • Foundation • Marketing • Operations	• Patients • Family members • Caregivers and staff • Clinicians • Physicians • Community • Infection control • Quality improvement mangers • Information systems managers • Medical records managers • Facilities managers	• Project managers • Medical planners • Interior designers • Architects • Landscape architects • Operations experts • Engineers • Construction managers • Wayfinding and art experts • Philanthropy managers • Vendors	• Academic researchers • Student researchers • Professional researchers • Internal researchers Staff support: • Quality improvement • Finance • Records • Information systems

Source: Adapted from The Center for Health Design (2009:8)

The interdisciplinary project team—"a group of experts from multiple disciplines both within and outside of the healthcare system"—should ideally be constituted at the conception of the project (The Center for Health Design, 2009:4). This will enable all the stakeholders to share the same vision and have the same understanding of the project goals, as well as steer the project development process towards the desired outcomes. By concurrently addressing multiple perspectives at all stages of the project development process, the interdisciplinary project team will ensure alignment between the project vision, strategic planning, design interventions, performance management and outcomes, as illustrated diagrammatically in Figure 2.1. The engagement of the interdisciplinary project team will also help ensure that the healthcare facility development process receives the administrative, financial, technical and cultural support that it requires to thrive. However, managing multiple perspectives as part of a participative approach to project planning, design and implementation will require the development of an organisational structure and decision-making protocol (The Center for Health Design, 2009).

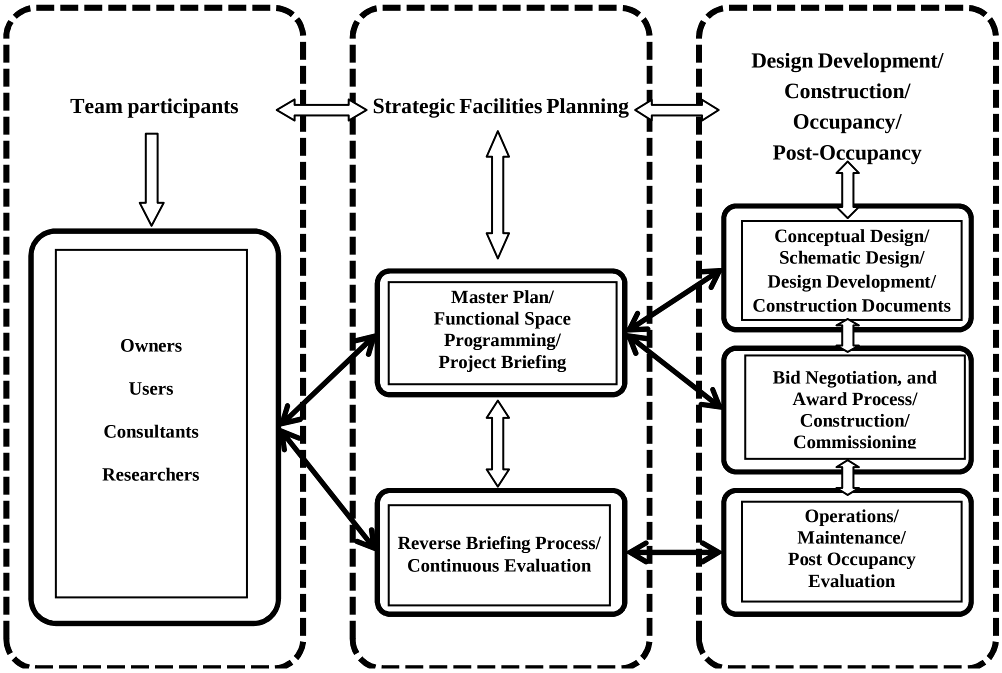

Figure 2.1: The role of the interdisciplinary team in the project development process

Benchmarking tools for evaluating the project development process are important to ensure that the stated project goals are met (Sadler et al., 2006). Indeed, research-based communication protocols and tools are needed to address challenges and problems that may impede the achievement of the stated goals (The Center for Health Design, 2009). This will avoid irrational changes to the proposed project brief, design solution and construction methods unsystematically without considering their manifold consequences (Malkin, 2002a).

New strategies need to be introduced in the DGs for healthcare facility development to encourage healthcare institutions to investigate the use of integrated delivery systems for healthcare facility projects (The Center for Health Design, 2009). In this regard, the new trend towards the use of integrated project development processes is mostly in response to the construction industry preference for the use of interdisciplinary project teams (Khan, 2009; Nestor, 2009). But it is also in response to poor communication systems; inefficient and ineffective project evaluation tools; poor participatory systems; lack of standardisation and institutional transformation; and technology innovation (Dainty et al., 2006). Such an approach calls for new financing models and ownership patterns which will further extend the involvement of interdisciplinary project teams (Prasad, 2008b).

2.4 Design guidelines for healthcare facilities: an overview

Healthcare service delivery in developing countries is facing many pressures—such as the effects of ill-managed urbanization which have increased the burden of communicable, non-communicable and chronic diseases; considerable and often growing health inequalities; and economic and political crises that are challenging government and institutional capacities to ensure access, delivery and financing (WHO, 2008). These pressures leave little time for analysing and assessing to what extent the vision, policies and design and development process issues that DGs were meant to address have been fulfilled (Meuser and Schirmer, 2006a) However, there is a growing consensus in the literature about the important role of DGs in improving the design of healthcare facilities (Anderzhon et al., 2007; Francis et al., 2001; Hayward, 2006b; Hignett and Lu, 2008; Malkin, 2008; Marberry, 2006; Meuser and Schirmer, 2006b; Purves, 2002; 2009; Schwarz, 2008; Svennson, 2008).

A wide range of issues relating to epidemiological patterns, space design and provision,[5] spatial relationships,[6] functional suitability,[7] quality of product, and aesthetics and cost, necessitates a continuous update of the DGs used for healthcare facilities project development processes (Beaver et al., 1991; Kleczkowski and Pibouleau, 1985). In sub-Saharan African countries, in particular, there has been a significant shift in government policy, which many now recognising the importance of DGs in healthcare facilities development (Abbott and Cowan, 1989; Nightingale, 2009). Indeed,

[5] The term space design and provision in healthcare facility design refers to spaces designed based on hierarchical task analysis, and providing design solutions that can improve caregivers work environment and patient/visitors satisfaction (Hayward, 2006a).

[6] Spatial relationships refer to the configuration and adjacencies of the space provision in a favourable arrangement based on the caregivers' daily shift workflow requirements (Hayward, 2006a).

[7] Functional suitability refers to the appropriateness of the space design and provision in relation to workflow processes taking place in the space or department (Hayward, 2006a).

> "design guidelines have the potential to diminish processes of marginalisation of access to healthcare facilities, reflected in the contemporary debates on poor status of healthcare facilities in the developing and developed countries" (Crisp and Liddle, 2008:12).

2.4.1 Definitions of design guidelines

As this study seeks *"to assess the role of design guidelines for A&E facilities in South Africa so as to make recommendations on how to improve their design and project development process"*, an important initial task is to establish an operational definition of the concept "design guidelines" as used in this research.

There are guidelines and norms in all human activities with varying degrees of regulatory content. They include social, cultural, political, working, quality, safety and design guidelines and norms (Elster, 1989). The main aim of developing DGs and norms, as articulated by the South African National Department of Health (1987), can be summed as follows: control over maximum area; control over production cost; control over standardisation of components; control over furniture and equipment types; and control over the procurement process.

In the context of healthcare facilities development, the American Institute of Architects Academy for Health (2006:xv) defines DGs as:

> "a generic design instrument, the main aim of which is to streamline design process according to set design standards: to support certain policy healthcare system framework and provide general rule for the overall stages of the project development and operational processes."

And according to the International Organisation for Standardisation (2009:79), DGs provide:

> "the parameters for space design, determination of the general and specific design requirements with consideration to the design development and operational processes, with particular concern relating to the minimal area needed within the limits of the space functional suitability and spatial relationships."

DGs are described by Sevensson (2008) as a set of tools necessary for addressing economic, social, cultural, and moral issues relating to the design, and management of the construction process. In practice, Beaver et al. (1991) contend, this requires efficient information and communication systems and knowledge dissemination channels.

DGs may be imperative, restrictive or merely indicative as overall guidelines. Some DGs embody obligations—they may mean minimum, maximum or optimum levels of achievements. Others provide information on input standards or define the proportion or nature of resources (space, equipment, personnel and other operational requirements) needed for healthcare services delivery. Still others focus on output standards, indicating the volume or type of production expected from the application of processes (such as capacity efficiency and throughput) (Hamilton, 2009).

DGs may be issued and used by any organisation, government or private, to influence decision making, presumably in a standardised predictable manner and to obtain a higher quality product (Valins and Salter, 1996). DGs need not be compulsory; but they can be made mandatory if required (Abbott and Cowan, 1989). For example, the Provincial Department of Health DGs in South Africa are mandatory for any healthcare facilities development projects within their respective jurisdictions (South African National Department of Health, 1987).

Given the above, DGs should provide evidence-based general and specific design requirements for space provision, functional suitability and spatial relationships. In the case of healthcare facility design, DGs can provide information on the current facility situation; future vision and facility planning objectives; current and projected workloads and hours of operation; current and projected staff population; operational and support systems assumptions; interdepartmental adjacencies and access; floor plan configurations; and other important factors that may influence the design of new facility or renovation works (Hayward, 2006a). However, Meuser and Schirmer (2006b:286) caution that while DGs may contain procedures that have been tried and tested in practice, "evidence applied to one situation may produce a completely different recommendation in another situation."

Most studies on DGs are based on this perspective, owing mainly to the significance of DGs in addressing social, economic, cultural and moral challenges encountered throughout the project development processes. However, the last decade has seen the emergence of new concepts and approaches that have influenced the definitions of DGs, one of the most important being the 'design and operational system-based perspective' articulated by The Center for Health Design (2009). This new concept focuses on providing information systems for the integration and management of project briefing, design, construction and operations so as to improve healthcare services delivery and achieve desired outcomes (Hamilton, 2008).[8]

The above definitions of the DGs may seem broad in scope, but this is due to their comprehensive and dynamic nature. Thus, the operational definition of DGs adopted for purposes of this study is:

> *" a set of principles and standards developed through research and practice-based evidence used for space design and provision, functional suitability, spatial relationships, and project development process for improved operational process and quality of healthcare services delivery."*

It is clear from this definition that DGs need to be continuously updated to reflect new knowledge gained through research on their application in practice for healthcare facilities projects briefing, design, procurement, construction, and operation and maintenance.

2.5 Design guidelines domains

The interpretation, translation and application of DGs are seen as a major factor for evaluating healthcare institutions, operational systems, processes and outcomes (Hamilton, 2002). Indeed,

> "understanding the main issues in the main domains of project brief and space narratives in the [design guidelines] influencing [healthcare facilities projects] is essential to the delivery of good design and improved physical environment" (Duffy and Hannay, 1992:10).

The main domains in the DGs, as identified by Duffy (1993), are: domain of functions; domain of statutory requirements; domain of procurement and construction systems; and domain of technical performance. These are summarised diagrammatically in Figure 2.2.

[8] See sections 2.10.3 and 3.18.1.

2.5.1 Domain of functions

Healthcare facility spaces are categorised into four main zones: medical, nursing, living and supporting areas. Traditionally each has had a specific functional focus, and has not been used for any other function. However, recently, owing to the recognised need for functional adaptability, patient/caregivers/community design approach and efficiency of space utilisation, healthcare facilities spaces are now being designed to be more flexible and adaptable for multiple use (Miller and Swensson, 2002). More specifically, medical and nursing spaces in A&E facilities are being designed as universal spaces which can be easily adapted to fulfil multiple functions.

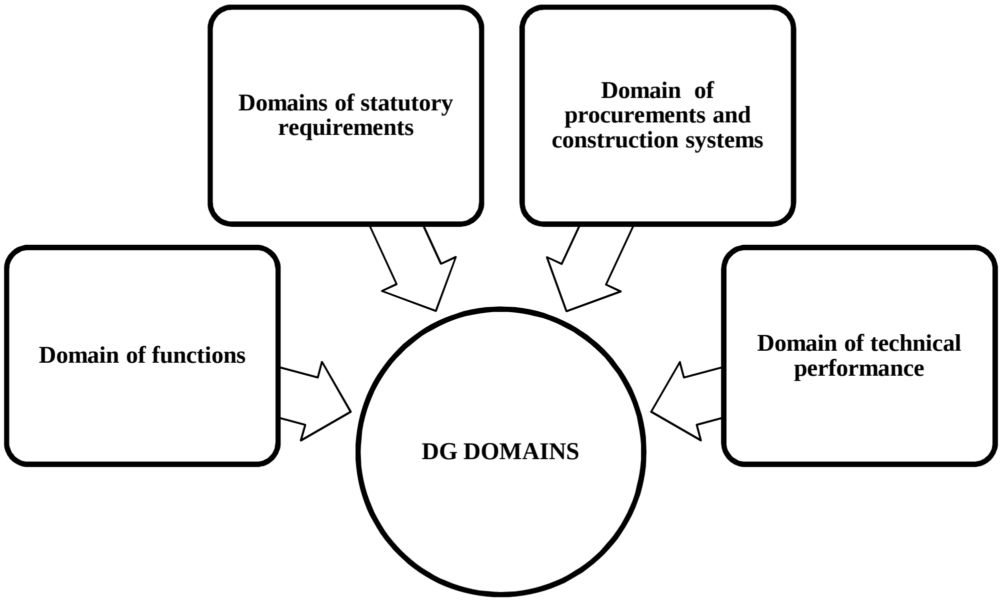

Figure 2.2: The key domains in the general and specific requirements in design guidelines

2.5.2 Domain of statutory requirements

Statutory guidance outlines the key principles and general directions that are likely to produce equitable distribution of healthcare resources (Thompson and Goldin, 1975). The domain of statutory requirements thus focuses primarily on issues of legislation; technical and functional standards; safety regulations and project budgets (Miller, 2007).

2.5.3 Domain of procurement and construction systems

The domain of procurement concerns project resources for healthcare facility development and is split into four sub-domains: traditional contracting; design and build; management based methods (management contract and construction management) and design and manage (consultant-based project management and contractor project management) (Greenwood and Walker, 2004). Three key factors influence the choice of construction system—time, cost and quality (Cartlidge, 2004).

2.5.4 Domain of technical performance

Criteria for benchmarking the technical performance of design solutions are a critical element of the DGs for healthcare facility development projects. Indeed, they are especially important in initial discussion documents for the strategic planning approach, design process, project cost, construction methods and operational systems envisaged for the healthcare facility (Mulva and Dai, 2009).

2.6 Theories in the history of design guidelines for healthcare facilities

The history of theories of DGs used for the development of healthcare facilities has been reviewed by several authors. However, Verderber and Fine (2000), distinguish six important periods that significantly influenced the genesis and evolution of DGs for healthcare facilities—the Early Ages; the Medieval period; the Renaissance period; the Nightingale period; the Minimalist Megahospital and the Virtual Healthscape.

The early ages

The design of healthcare facilities in Greek and Roman times was based on the theory of the sanctuary of Epidaurus—healing through divine cures—in which nature and afterlife played a principal role in the healing process (Stern, 1969). Space design and provision was influenced by concepts of identity; obligation; influence; needs; suitability; usability;

knowledge and involvement; and consequently focused on the concept of humanisation of the physical environment (Pile, 2009). The criteria used for space design and provision gave ample information for communicating the vision, and also provided for continuous monitoring of and feedback on the achievement of the project vision (Chopra, 1987). In addition, "there is hard evidence that the use of private rooms appeared nearly three thousand years ago in the Greek Asclepion" (Verderber and Fine, 2000:10).

Innovative methods for evaluating three important design goals—functional, structural and aesthetics—were defined by Vitruvius in the 1st Century BC, based on the notion that design that is fit for purpose meets three conditions: Commodity, Firmness and Delight.[9] Vitruvius' principles have been elaborated and given wider application in the six fundamental principles for evaluation of the quality of the space design and provision, functional suitability and spatial relationships categorised as: order, arrangement, eurhythmy, symmetry, propriety, and economy[10] (Clark, 2008).

The medieval period (AD 500 - 1400)

A&E facilities, according to Scully (1961), originated in the medieval period, when they were first built to provide medical care to the soldiers. Thus, the early example of what has become known as the medical model of healthcare architecture was based upon the military model design philosophy and theories (Clark, 2008). There was, however, a high patient death rate from waterborne diseases. This prompted the introduction of technology innovation through, for example, the design of effective and efficient water supply and sewage disposal systems to overcome the challenges of hospital acquired infections (HAI) (Prasad, 2008a; Purves, 2009).

[9] Generally, a complete theory of architecture has been assumed to always be concerned essentially in some way or another with these three interrelated terms, which, in Vitruvius' Latin text, are given as *firmitas*, *utilitas*, and *venustas* (*i.e.*, structural stability, appropriate spatial accommodation, and attractive appearance).

[10] Order and arrangement are defined as two important concepts for design. The basis of order is based on the functions of the elements of a building

- Arrangement is the process of defined elements of a building in a correct functional relationship.
- Eurythmy is perceptual and defines elements of a design that are in harmonious and pleasing relationship.
- Symmetry is the successful balance of the individual elements of the design of a building.
- Propriety is the quality of the finishes product achieved based on effective and efficient DGs.
- Economy is measured based on effective and efficient use of DGs for decision making to achieve good quality product within reasonable cost (Clark, 2008).

The renaissance period (AD 1400 – 1550)

The use of symmetry was strongly influenced by classical architectural language precedents, which was a dominant concern in renaissance healthcare facilities (Clark, 2008; Murray, 1966; Thompson and Goldin, 1975). Furthermore:

> "the renaissance period saw the development of architecturally planned buildings with symmetrical, axial plans and formal facades. Many of these were constructed in response to the declining standards of hygiene that saw the spread of disease and plagues throughout parts of Europe" (Verderber and Fine, 2000:10).

The first renaissance period architecturally designed healthcare facility, Brunelleschi's Foundling Hospital in Florence, Italy, exemplified Vitruvius' design principles of "commodity", "firmness" and "delight", which were developed as criteria for evaluation of space design and provision, functional suitability and spatial relationships (Lowry, 1962).

Nightingale period (mid-19 Century)

Florence Nightingale introduced an innovative approach which focused on the improvement of healthcare facilities design based on the following concepts: space organisation and openings; space articulation and disclosure; and the introduction of spatial level of autonomy for evaluation of space design and provision, functional suitability and spatial relationships (Aycliffe et al., 2001; Hong, 2009; Kudzma, 2006; Nightingale, 1859; 1863). The total number of beds in a single inpatient facility was reduced to 40 and mobility of caregivers was addressed by positioning the nurses' station to minimise travel distances during workflow processes. Interior materials were unprecedented; and natural ventilation and heating systems, were introduced for the first time (Anderson, 1993; Davidson and Ray, 1991; Jenso and Haugen, 2004; Miller and Swensson, 2002; Nightingale, 1858). Important criteria were also developed for evaluating inpatient accommodation; window sizes and their placement in relation to beds; and overall ambience (Nightingale, 1969).

The first healthcare facility to use the new criteria was St. Thomas Hospital, London, commissioned in 1871. The linear configuration of the inpatient facility and supply-spine corridor for the public and supplies were space design and provision concepts introduced to reduce hospital acquired infections (HAI) (Verderber and Fine, 2000).

The minimalist mega healthcare facilities

The 'Minimalist Megahospital' is a term used to describe the large high-tech healthcare facilities that were developed in response to the increasing demand for hospital beds; the rising cost of land (Cox and Groves, 1990; Flynn, 2003); and the complex scientific medical technologies that dominated healthcare in the 20th Century (Ghirardo, 1996). The development of multi-storey buildings of up to fifteen floors and deep space design (Conway, 2005; Gropius, 1965) stimulated the use of more specialised healthcare departments in one building. This in turn led to categorisation of healthcare departments into three key functional zones: (i) the clinical zone—spaces for diagnosis, treatment and surgery; (ii) the nursing zone—in-patient areas; and (iii) the support zone—all other ancillary and support spaces (Kellman, 1989; Malkin, 1992a; Miller and Swensson, 2002; Verderber and Fine, 2000).

However, as Dall'Olio (2002:14) affirms, 'minimalist megahospitals'

> "...[became an] anachronism when they opened in an era of a restructured healthcare systems soon to be refocused on community-based managed care [and] therefore symbolized to critics everything wrong with the healthcare system in advanced industrialised nations."

The virtual healthscape

The alternative approach to the design philosophy of the minimalist megahospital was a move towards 'residentialist imagery, which was represented by the 'Virtual Healthscape'. The virtual era (informatiques, e-medicine) in the health sector essentially commenced in 1990. Since then, design guidance has dynamically changed, as information technology influences healthcare systems and facilities, as well as perceptions of personal care (Dalamagka et al., 2005).

> "The Virtual Healthscape anticipates more flexible and open systems for healthcare [as] technology innovations are permitting healthcare solutions that offer greater choice, flexibility and accessibility for everyone" (Verderber and Fine, 2000:16).

'Humanisation' of healthcare facilities has thus become a primary objective of healthcare institutions (Dall'Olio, 2002). Humanisation has to do with quality spaces for patients, caregivers and visitors, including interiors, finishes, materials and colours. The paradigm shift is in response to evolving physical, intellectual and emotional needs of patients for a supportive environment and human relationships and a sense of control over their lives and an opportunity for meaningful participation (Orr, 1989). These are the founding principles of the Planetree model for healthcare facility development (Frampton, 2000).

2.7 Planetree Philosophy

2.7.1 Historical background

"Planetree" [11] is a translational and transformational philosophy used today mostly in: USA; Canada; Australia; UK and the Netherland, for developing and updating of existing DGs for healthcare facilities projects. The Planetree philosophy was developed by Angelica Thieriot in 1978 following her poor experiences with healthcare services delivery and the healthcare facility environment as she battled a rare viral infection. This led her to envision a different type of facility where patients could receive care in a truly healing environment that would also provide them with access to the information needed to become active participants in their own care and wellbeing (Frampton and Charmel, 2009; Lindheim, 1979).

2.7.2 The Planetree model

The Planetree philosophy focuses on delivering health care that is primarily based on patients-centred care. It emphasizes that healthcare facilities can provide space design that welcomes patients, families and visitors; values people over technology; encourages full participation of patients and families as partners in their care; provides flexibility to personalise the care of each patient; encourages interaction and social relationships between

[11] "Planetree" philosophy takes its name from the roots of modern Western medicine and the tree that Hippocrates sat under as he taught some of the earliest medical students in ancient Greece (Frampton and Charmel, 2009).

patients/caregivers/visitors; and creates access to the natural environment. The key principles of the Planetree philosophy include (Frampton and Charmel, 2009):

1. Provision of waiting areas with outdoor garden;
2. Provision of resource areas with educational facilities;
3. Provision of ample space in examination/treatment/clinical observation units for caregivers, families, and visitors;
4. Encouragement of human interaction;
5. Introduction of natural light in the clinical, nursing, and support areas;
6. Reduction of noise levels, improved privacy, and dignity of patients;
7. Dedicated paediatric areas;
8. Access to information can empower individuals to participate;
9. Improved physical environment can enhance healing, health and well-being;
10. Opportunity for individuals to make personal choices.

The Planetree philosophy also promotes decision making on space design and provision based on evidence and knowledge about the impact of those decisions on quality, cost, operations and management (Frampton and Charmel, 2009; Sadler et al., 2008).

Healthcare facilities DGs are now based on the Planetree philosophy to improve on issues of human communication, interaction and relationships (Malkin, 2008). These concepts and theories are important for improving caregivers' workflow processes which affect quality healthcare services delivery to the patients, and also family members and community experience (Frampton and Charmel, 2009).

2.7.3 The relevance of Planetree philosophy for DG update

> "The concept of healing has broadened dramatically in the last century; this has resulted in striking changes in the [DGs used for] design of healthcare environments and positive effect on the healing process of individuals. To ensure the designers remain effective, those who plan and design healthcare spaces must remain attentive to any evidence that verifies the effect of healing environments on patients, their families and healthcare personnel" (McCullough, 2010:43).

As observed by The Center for Health Design (2010:5):

> "Several developments in the healthcare industry in the last 10 years made it critical to understand how the physical environment is a part of the bundle of strategies to improve the quality of care. Since the [DGs] used for the physical environment can potentially contribute to or aggravate these problems, it is essential for healthcare design teams to closely examine the relationship between buildings design and patient, staff, family, and environmental outcomes"

The design of patient-family-focused healthcare environments based on Planetree philosophy may take on a variety of conceptual attributes which may vary by type of: healthcare facility; cultural imperatives; budgetary constraints and urban context (Frampton, 2000). The criteria for creating physical environments that promote caring are based on application of the following Planetree principles in the DGs used for space design and provision, functional suitability and spatial relationships (Lindheim, 1979):

1. Communication;
2. Effectiveness and efficiency use of resources;
3. Participation;
4. Technology innovation;
5. Institutional transformation; and
6. Standardisation.

2.7.4 The influence of Planetree philosophy in healthcare facilities projects

The process of designing healthcare facilities environment is complex and challenging (Codinhoto et al., 2010). Indeed, there are multiple issues to be addressed including the healthcare delivery model; number and variety of users (caregivers/patients/family/visitors); space design and provision; functional suitability and spatial relationships; physical environment and project development process (Stichler, 2007). DGs based on the Planetree philosophy can positively influence functional suitability and spatial relationships if they include specific metrics for the evaluation, education and continuous feedback process (Hamilton, 2009). The use of DGs based on the Planetree philosophy for making design decisions may impact positively on the quality of physical environment and care to patients owing to (The Center for Health Design, 2010):

- Noise reduction;
- Access to daylight;
- Appropriate lighting;
- Access to nature;
- Appropriate use of technology;
- Decentralised observation, supplies and charting;
- Reduction in walking distances;
- Improved social interaction;
- Positive distraction.

Studies have demonstrated that healthcare environments designed using DGs based on the Planetree philosophy can be cost effective by improving patient outcomes, reducing average length of stay and enhancing caregivers and other users' satisfaction (Sadler et al., 2008). Indeed, research-based DGs based on the Planetree philosophy can influence patients, caregivers and other users experiences in positive ways throughout the facility—from the public parking lot, approach and entrance spaces; through to the private clinical spaces (examination/treatment spaces) and patient rooms (Hamilton, 2009).

2.7.5 The effect of Planetree philosophy on healthcare services delivery

Poor design of patient-care units, examination/treatment rooms decreases the time caregivers have available to assess and provide direct care to their patients (Guenther and Vittori, 2008). However, designing patient-focused healthcare environments using research-based DGs can potentially address challenges relating to how healthcare facility design contributes to patient-care quality and safety, and satisfaction of both patients and caregivers (Hamilton, 2009). Hence, the Planetree philosophy has become the industry role model for the design of healing and humanistic care by improving (Frampton, 2000):

- Awareness, use and compliance to DG;
- Healthcare facilities development goals;

- Healthcare facilities space design and provision;
- Quality of healthcare services delivery;
- Technology innovation; and
- Standardisation of the design and operational process

Many studies have evidenced that DGs used for healthcare facilities based on the Planetree philosophy can positively affect clinical outcomes (Ulrich et al., 2008:72). Facilities are now, more than ever, attempting to create spaces that support the need for improved patient outcomes and satisfaction, staff retention, and organisational processes through standardisation of the design and operational procedures (Francis et al., 2001).

In 2006 the researcher became a professional affiliate member of The Center for Health Design based in California, USA; and has since regularly attended the annual conferences organised by The Center. During each conference, there have been field visits which have given the researcher the opportunity to visit some A&E facilities in the USA, built based on the Planetree philosophy. Gaining access to these A&E facilities would otherwise have been extremely difficult without the necessary permission from the various healthcare institutions and respective human research ethics committees.

The A&E facilities described below, which the researcher was able to visit, have used DGs based on the Planetree philosophy for design, project development and operational processes. However, it was not permitted to take photographs of these A&E facilities owing to the personal and sensitive of the nature of the healthcare services delivery.

A&E facility at the Swedish medical center ─ Issaquah Washington: designed by Callison Architecture. Visited by the researcher in November 2006

The A&E facility at the Swedish medical Center is a double-storey building with deep space floor plan arranged in L-shape, with public areas wrapped around the examination rooms and caregiver’s areas. The structural frame is in reinforced concrete and steel structural columns and beams, as are the ambulatory and A&E ambulance entrances. The exterior aesthetics, materials and finishes are environmentally sensitive, and less institutional, in conformity with the Planetree philosophy.

The facility aims to provide the best possible experience for patients and their families. It has 14 universal examination/treatment rooms for treating emergency patients; three observation rooms for patients requiring diagnostic observation, treatment and follow-up: and a full-service clinical laboratory.

The DGs for the universal examination/treatment rooms enabled separate clinical zones for more efficient and effective workflow processes through standardisation of the spaces.

The researcher observed that universal examination/treatment rooms in separate clinical zones encourage participation and social interaction and support patient-centred, family-focused care. Separation of patients', caregivers' and public zones creates an effective and efficient physical environment. Standardisation of spaces can positively influence workflow processes, resource use and capacity efficiency, thereby, reducing patient waiting times and improving healthcare services delivery as well as patients' and caregivers' safety.

The DGs used for the space design and provision, and functional suitability for this A&E facility also influenced the introduction of a technologically advanced information system─InfoPath technology, designed to facilitate access and update of patient records. The information system is also used to order laboratory studies, monitor patients' conditions and view reports: and can thus reduce turnaround times for healthcare services delivery.

Parklands Hospital in Dallas Texas: designed by FKP Architects. Visited by the researcher in November 2007

The DGs used for this healthcare facility was based on Planetree principles. The A&E facility at Parklands Hospital is located on the ground floor of the multiple-storey building with a deep space floor plan arranged in T-shape. The structural frame is in reinforced concrete and steel structural columns and beams, with glazed façade. The ambulatory and A&E ambulance entrances are situated under the elevated four-storey diagnostic and clinical building. The waiting areas are located within the ambulatory entrance area, adjacent to the universal examination/treatment rooms and caregiver's areas, with a view of the external landscaped garden. The external architectural treatment is sensitive to the surrounding hospital buildings, but materials and finishes are less imposing and subtle with corporate office buildings aesthetics.

This A&E facility has three separate clusters universal examination/treatment rooms areas known as "PODs" strategically located close to the triage space. One POD consists of 30 universal examination/treatment rooms for treating emergency patients and six observation rooms for patients requiring further medical attention and clinical observation. The space design of the admissions and registration areas leads straight to the PODs, potentially improving the efficiency at triage and, thereby, positively influencing average patient turnaround time. Direct access to patient and surveillance from the circulation areas improves privacy and dignity of patients. Access to natural light and noise control improves the physical environment comfort of patients, caregivers and other users of the facility.

The overall observation was that the physical environment of this facility promotes and supports patient-centred, family-focused care. The space design provides a quality physical environment for patients through the optimization of daylight, access to nature, privacy and noise control.

The A&E facility is also designed to maximize flexibility, adaptability and expansion capabilities: both horizontal and vertical should the need arises.

ER One Institute, Washington Hospital─Washington DC: designed by HKS Architects. Visited by the researcher in November 2008

ER One A&E facility at Washington Hospital is a multi-storey curvilinear building, with a reinforced concrete and steel structural columns and beams, glazed façade, and deep space floor plan. The ambulatory and A&E ambulance entrances are in steel structural columns and beams with flat roofs. The public waiting areas are located on the outer part of the arched-shape building, adjacent to the universal examination/treatment rooms and caregiver's areas with a view of the external landscaped garden. The exterior architectural treatment is environmental friendly and sensitive to the surrounding hospital buildings, while materials and finishes are subtle with residential aesthetics.

This A&E facility has three "PODs" each consisting of 20 universal examination/treatment rooms for treating emergency patients and five observation rooms for patients who require further clinical observation. The space design of the floor plan allows for the future expansion of the current number of universal examination/treatment rooms in each "PODs" in response to varying demand. The introduction of glazed screen and partitions on the outer walls of these rooms along the caregiver's circulation space enabled direct access and surveillance of the patient. Privacy and dignity of the patients when required can be achieved by the use of louvre blinds within a double-glazed panel.

Information systems and equipment storage are located at the bedside for ease of access; and electrical and mechanical outlets and data networks are included in nonclinical spaces for increased flexibility and adaptability of all spaces. The use of ergonomic workstations and seating improves caregivers' operational processes, relationships and interactions. A technologically advanced medical imaging centre with MRI, CT scan, X-ray and ultrasound equipment are provided along with clinical laboratory services in this facility.

The researcher noted from the visit to this A&E facility that the pursuit of openness and transparency makes maximum use of light and views provided by the internal atrium and it is an integral part of the building appeal. The natural light from the atrium provides therapeutic environment that can responds to patients needs for a space that is not “like a hospital” which affords them the feeling of being outside in a natural environment even when that is not possible.

The researcher’s general observation was that the incorporation of Planetree principles in this facility has improved patients’ and caregivers’ well being which was the key design goal of the healthcare institution. The DGs used for this facility also focus on the introduction of built-in surge capacity through the use of following concepts: flexibility; mobility; resources use; capacity efficiency; and standardisation of operational spaces and workflow processes.

Figures 2.3 to 2.8 illustrate universal/examination patient rooms, waiting areas and landscaped courtyards designed using DGs based on the Planetree philosophy. The three healthcare facilities described above have similar design and architectural solutions, aesthetics and design features to those illustrated in Figures 2.3 to 2.8 below.

2.8 Applicability of Planetree philosophy in South African

Existing public healthcare facilities in South Africa are perceived as frightening and unfamiliar places for both users and caregivers. Emotions of alienation, fear, hopelessness, loneliness, and dehumanisation often overwhelm patients. Indeed, the first impression at the entrance, reception areas of most of these healthcare institutions are unwelcoming and seemingly uncaring (see Appendix A). In these institutions patients’ family members and friends can only spend minimal time with the patients, in a noisy and crowded spaces with less dignity and privacy (Okpanum, 2003).

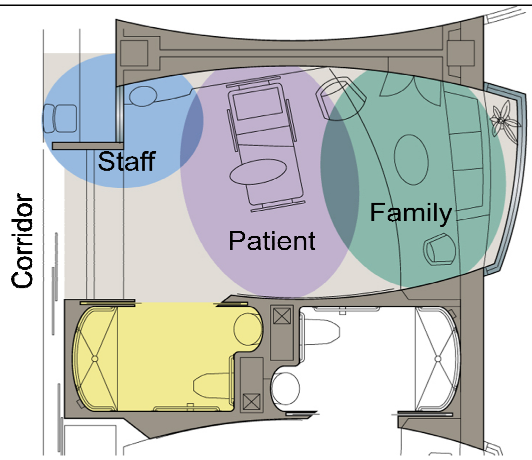

Figure 2.3: Design concept for universal patient room floor plan at Bronson Methodist Hospital, Minneapolis, USA, designed by Ellerbe Becket Architects. The space design concept provides for: staff and family areas and added patient privacy by allowing surveillance by staff area outside the patient room. *Source*: Dilani, (2001).

Figure2.4: Patient room at Seattle Children's Hospital, Seattle USA, designed by Anshen and Allen Architects. The seating area below the window is used as the family area, thus, allowing uninterrupted access to the patient. *Source:* Dilani, (2001).

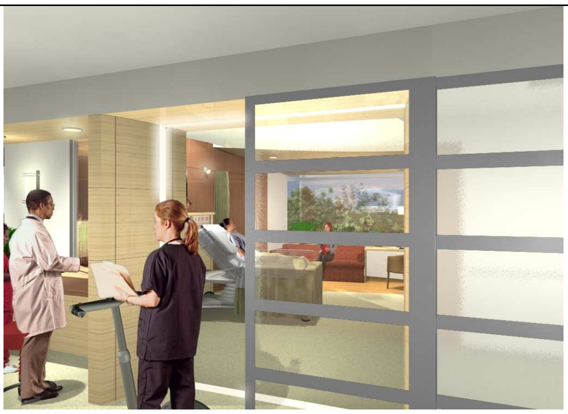

Figure 2.5: Perspective view of the typical universal examination room at Bronson Methodist Hospital, Minneapolis, USA, designed by Ellerbe Becket Architects. The space design concept enables surveillance of patients by the caregivers from outside the patient room. *Source*: Dilani, (2001).

Figure 2.6: Waiting area at Stanford Hospital, Stanford, California designed by Anshen and Allen Architects. The space design of the waiting area allows views of the landscaped gardens and external environment from the inside. *Source*: Dilani, (2001).

Figure 2.7: Landscaped courtyard at University of Michigan Medical Centre designed by Shepley Bulfinch Architects. The design of the landscaped courtyard allows users direct contact with natural environment. *Source:* Dilani, (2001).

Figure 2.8: Landscaped atrium at Martini Hospital, Groningen, Holland designed by Burger Grunstra Architects. The space design concept of this area provides for natural light through the atrium which is covered in glass. The seating and trees encourage social interaction with the "natural" environment. *Source*: Dilani, (2001).

Until recently, healthcare systems policy has consistently argued that the quality of the environment should remain secondary to the top priority of healthcare services delivery (Purves, 2002). Indeed, much of the thinking has focused only on cost-benefit analysis (Sadler et al., 2008). This is a major reason why there has been little emphasis on the update of the DGs used for development and improvement of healthcare facilities (Hayward, 2006). Hence, for the past 50 years, most healthcare facilities in South Africa have failed to provide a therapeutic and conducive environment for users (Okpanum, 2003).

There are many similarities between the Planetree nursing philosophy and traditional African medical treatment approaches, in particular on issues relating to human interaction; human touch; and unlimited access to families and friends. Access to information in Planetree healthcare institutions is unrestricted, and family members and friends are encouraged and enabled to spend time with patients to prevent loneliness and isolation (Frampton and Charmel, 2009; Okpanum, 2003). Hence, in this regard there is thus need for continuous updates of DGs used for healthcare facilities to provide the healing and spiritual uplifting that a good building can provide through the improvement of the operational processes. Translating awareness, use and compliance to DGs based on Planetree philosophy into practice is thus an important issue to be addressed by both healthcare institutions and design professionals (Hamilton, 2002; Purves, 2002; The Center for Health Design, 2008, 2009).

The applicability of the Planetree philosophy in the South African context will depend on the challenge of demonstrating empirically that research-based DGs will improve the design of healthcare facilities, project development process and healthcare services delivery (Okpanum, 2003). Surprisingly, there is limited research work in this field. However, a large body of opinion is now rapidly growing toward the challenge of providing answers to the relationships between patient medical outcomes and therapeutic environmental issues.

The concepts and theories of the DGs and Planetree nursing philosophy in relation to natural, built, social and symbolic environments are summarised in Table 2.2.

Table 2.2: Concepts and theories of design guidelines (DGs) based on the Planetree philosophy

<table>
<tr><td colspan="2">Structure of the DGs: 1. Healthcare needs. 2. Resources and compliance perspectives. 3. Information systems on project setting. 4. Information systems on socio-political and economic issues. 5. Technology innovation and updates (South African National Department of Health, 1987).

Structure of DGs based on Planetree principles: 1. Design briefing tools and culture of learning. 2. Users and influence of effective and efficient design tools. 3. Community expectation and participation perspectives. 4. Attitude and behaviour of stakeholders and value systems 5. Influence of standardisation on the project development process and operational systems (Frampton et al., 2003; Hamilton, 2008; Lindheim, 1985; Sadler and Ridenour, 2009).</td></tr>
<tr><th>Planetree nursing philosophy</th><th>DGs update theories and concepts based on Planetree nursing philosophy</th></tr>
<tr><td>Natural environment: Nature is introduced into healthcare environments in many ways: views from windows, specifically designed healing gardens, sunlight coming through clerestory windows, feature walls of local stone and strategies to include natural processes for the indoor environment. Exposure to nature can help relieve stress and create feelings of connectedness to the outside world: adapted from Lindheim, (1985).</td><td rowspan="4">o DGs as a medium of communication
• Communication
• Translation/interpretation
• Continuous feedback
• Evaluation
• Education

o The importance of DGs on effective and efficient healthcare facility
• Integration
• Distribution
• Equity
• Attachment
• Value for money

o Participatory approach for DGs update and use
• Identity
• Obligation
• Influence/Needs/Usability
• Knowledge
• Involvement

o Technology innovation and update through DGs
• Performance
• Operational process
• Continuity
• Information systems/Visualisation
• Physical environment

o The role of DGs in institutional transformation and change
• Accessibility
• Management
• Quality of services delivery
• Procurement
• Experience

o Standardisation of project development process and life-cycle costing
• Repetition
• Pre-assembly
• Aesthetics/durability/serviceability
• Flexibility/Adaptability
• Satisfaction

The constructs and concepts outlined above are adapted from (Frampton et al., 2003; Hamilton, 2008; Lindheim, 1985; Sadler and Ridenour, 2009)</td></tr>
<tr><td>Built environment: At their best, they provide a more efficient, effective and healthier environment for all categories of users, if the DGs used provide knowledge system for addressing these issues: communication; evaluation; translation; integration; distribution; equity; attachment and value for money.
Movement is all important to caregivers who can suffer movement-related fatigue, frustration and distraction, due to: poor accessibility, management and operational systems of the floor plan configuration. On the other hand, well-considered wayfinding and spatial relationships solutions during space design and provision should enhance everyone’s physical comfort, performance, quality and time.
The poor information systems in the DGs used for space design and provision, the healthcare facilities provided are the most complained about, since they frustrate the intentions and experience of the users. Function, operational process flow, ergonomics, materials, tasks and events are all sub-categories of the built environment dimension that should be addressed through continuous improvement of the DGs used for project development processes: adapted from (Frampton et al., 2003).</td></tr>
<tr><td>Social environment: Space design and provision, functional suitability, spatial relationship and the scale of the social environment spaces are important especially when they are flexible and adaptable to accommodate changes that inevitably will occur in time. When the DGs used for space design and provision provides tools to reflect and celebrates the special characteristics and richness of the community, it promotes feelings of pride and ownership, in particular: identity, obligation, influence, knowledge and involvement. Clarity of space organisation and visual connections to destinations and also to allow for individuals to withdraw can help to engage all users, as well as foster improved communications and education: adapted from Hamilton (2008).</td></tr>
<tr><td>Symbolic environment: Findings indicated positive symbolic intervention is linked with the appropriate choice of materials, colours, textures, furniture, finishes and other interior settings, artworks and informing communicative value on: aesthetics, satisfaction and experience: adapted from Sadler and Ridenour (2009).</td></tr>
</table>

2.9 Structure of the DGs for healthcare facilities

The development of DGs requires a wide range of background information relating to healthcare needs (established healthcare problems, disease patterns, birth and death rates); information systems on socio-cultural and economic issues; information systems on the project setting; resources and compliance perspectives (human and financial resources, furniture, equipments and project development tools); and technology innovation and updates (Abbott and Cowan, 1989; Hamilton, 2006a; Hayward, 2004; 2006a; b; Kemper, 2004; Kleczkowski and Pibouleau, 1985; Meuser and Schirmer, 2006b; Weitzner, 2006). The relationship between the structure of the above-mentioned key dimensions and sub-dimensions of the DGs is summarised diagrammatically in Figure 2.9.

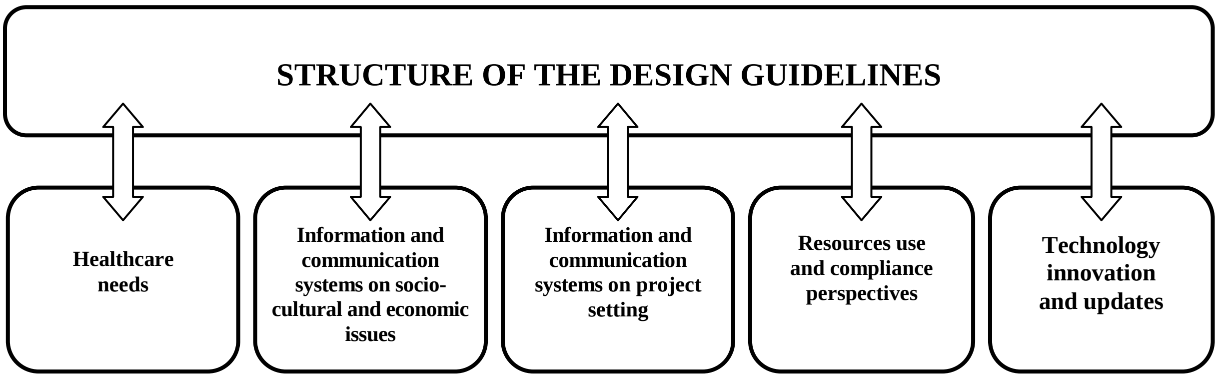

Figure 2.9: Structure of the design guidelines key dimensions and sub-dimensions

2.9.1 Healthcare needs

Healthcare needs data should provide evidence-based information on health problems, disease patterns, birth and death rates, taking into consideration present and future trends. The demographic and political information required includes background details on local communities served; size of the population and target groups to be served; local customs and traditions; and data on types of available healthcare facilities and levels of services delivery (Deshmukh and Minnick, 2006).

Healthcare strategic planning data required include: space requirements; equipment and furniture requirements; design; information technology systems; materials; construction and post occupancy evaluation (POE) information. Space design and provision, functional suitability and spatial relationships require varying levels of detail at different phases of facility planning process (Weitzner, 2006).

2.9.2 Information and communication systems on socio-cultural and economic issues

A comprehensive background understanding of the socio-econo-political context and local issues, as well as an understanding of users' needs and their experiences on the use of the existing facilities is fundamental to the DGs development and update process (Waite, 2005). Comprehensive information systems on the local socio-cultural and economic context in the DGs are important for two reasons: (i) to ensure efficiency in resources use; and (ii) to ensure provision of healthcare facilities in all communities so as to improve equity, efficiency, effectiveness responsiveness of the healthcare system (WHO, 2000).

Data on socio-cultural issues in the DGs: Information on social issues influences space design and provision with a residential design philosophy—design of spaces that facilitate caregivers/patient/community interaction; introduction of cafes, library/resource areas; and more single-patient rooms in healthcare facilities (Brown and Gallant, 2006). Hence the importance of introducing research based design tools in the DGs update that consider socio-cultural issues in the development of healthcare facilities.

The importance of economic data in DGs: Information systems and data on the economy of the location in the DGs influence choice of design solution, construction systems, materials and finishes (Stichler, 2009); hence their importance for early establishment of benchmarking tools for project cost in the DGs for healthcare facilities development (Huelat, 2007). It is also important to distinguish between the initial cost of the project and life-cycle cost as the design solution and choice of materials have cost implications for the latter (Sheppard, 1989).

> "As design cost of the hospitals are typically a tenth of construction cost, these figures at least open the possibility that relatively small initial expenditure will pay for itself in the long run, perhaps many times over " (Prasad, 2008a:6).

Project development processes are, however, seldom research based, resulting in construction cost overruns owing to poor understanding of the implications of the choice of design philosophy and concepts; poor assessment of current and future needs; and poor analysis of the consequences of the design in relation to land use, space provision, functional suitability and spatial relationships (Mulva and Dai, 2009). As value engineering in today's healthcare facility is a continuous process, provision of a continuous feedback process in the DGs is necessary (Watkins et al., 2009).

2.9.3 Information and communication systems on the project setting and long-term development options

The information systems relating to the project setting are important for developing DGs used for healthcare facility development (Deshmukh and Minnick, 2006). However, data collection processes for evaluating the type and level of healthcare facility to be provided for a certain location, when provided in the DGs, are sometimes outdated (Gow, 2007). Hence, information on the project setting may not be based on actual needs of the community (Crisp and Liddle, 2008). DGs should thus include strategies for the development of research-based information systems relating to the project setting for new or renovation work (Zuckerman, 1998). As Rengel (2007:93) indicates:

> "a project's immediate physical context, its surroundings, is the most tangible context and requires proper understanding by the designer...[and] provides the most significant information requiring a design response".

Hence, data on the project setting should inform general and specific design requirements in the DGs to address the following challenges caregivers face daily: control of access into the healthcare facilities; surveillance of all those in the waiting area; identification of inappropriate incidents; long waits for patients; monitoring of patients; violence towards staff; and lack of privacy and dignity for patients; and wayfinding.

2.9.4 Resources and compliance perspectives

A good understanding of the available resources and how they can be effectively used can improve healthcare services delivery facilities (Burk and Kurrasch, 2006). Indeed,

> "...knowledge on concepts and challenges impacting the available resources is critical in order to enable all stakeholders to identify and implement potential solutions through participatory approach that can affect positively the quality of healthcare services delivery" (Zhao, 2009:12).

The method of use of available resources will differ from one context to another; hence, evidence gathered from one setting may not directly be applicable or transferable to another situation (Kleczkowski and Pibouleau, 1983; Weitzner and George, 2009). It is, therefore, vital that the information systems in the DGs for healthcare facilities development address two key issues—human resources and building resources (project development tools and construction materials) (Garber, 2006; Schein, 2004). Skills shortages in healthcare facility development are a major constraint to effective and efficient use of resources (human, knowledge and capital resources) in most developing countries, including South Africa.

There should thus be a concerted effort to understand individual institutional cultures and operational approaches in different settings in relation to resources use before proceeding with a strategic and business case for the project development process (Palomar Pomerado Health, 2006). It is also important that:

> "An estimated budget for a project is...established as part of the master planning process−a high-level process that evaluates project needs for a healthcare system, created years before the project is launched" (The Center for Health Design, 2009:28).

2.9.5 Technology innovation and the importance of effective and efficient DGs

Technology innovation presents opportunities for effective provision of healthcare services based on scientific knowledge and mitigation of waste of available resources (Hiller, 1996; Mulva and Dai, 2009; Nestor, 2009; Weitzner and George, 2009). And today's environment is marked by increased choice in the type of technology to be used for healthcare facility project development and operational processes (Barlow, 2008). Technology innovation can be used for improving communication, translation and evaluation in the project design and development process. For example,

> "[m]ock-ups are a powerful simulation technique, which may be used to: identify and test potential design solutions to everyday challenges in healthcare delivery that are the result of facility designs; [and] let designers and their clients experience built solutions to healthcare delivery challenges before final construction..." Watkins (2008:66).

However, owing to lack of benchmarking tools for choice of technology in the DGs for healthcare facilities projects there is little integration of technology in space design and spatial arrangements (Mulva and Dai, 2009). As a consequence,

> "Opportunities offered for good choice of technology are rarely used during strategic and business planning, resulting in the designing of less flexible and adaptable facilities" (Kahn, 2009a:4).

Application of technology for streamlining communication for project brief definition is also underutilised (Barlow, 2008). Furthermore, there is little emphasis in the DGs on the use of technology for determining workload capacity needs and other necessary information for space design, strategic and business case reports (Hayward, 2006a).

Access to adequate healthcare systems is still a widespread problem, particularly in developing countries. In this regard, new information and communication technologies (ICTs) are key resources for the fulfilment of the Declaration of Alma-Ata of 1978 of "Health for All" (WHO, 1978).

2.10 The structure of the DGs based on the Planetree principles

The DGs for healthcare facilities projects are influenced by several real-life issues and factors, including design briefing tools; culture of learning; efficient and effective design tools; community expectation and participation perspectives; stakeholders' values, attitudes and behaviours; and the influence of standardisation on project development and operational processes (The Center for Health Design, 2008). DGs for healthcare facilities development based on Planetree principles respond to these influences. The structure of DGs based on Planetree Principles is summarised diagrammatically in Figure 2.10.

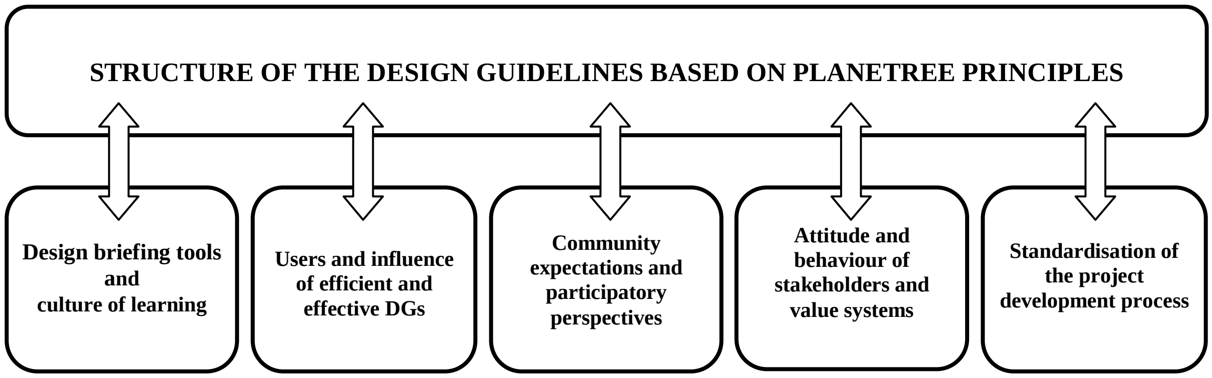

Figure 2.10: The structure of the DG based on the Planetree Principles

2.10.1 Design briefing tools and culture of learning

The relationships between the information systems in the DGs and design briefing tools directly affect the outcome of healthcare facilities project development processes (Eckel et al., 1998). Indeed, "it is recognised that at least 80% of the costs are determined at the front-end of the [design] process, at the briefing and design stage" (Tzortzopoulos et al., 2006:657). As Heidegger (1971a:15) puts it:

> "Information systems in the design guidelines and design briefing tools can be compared to "cultivation systems" and "land", as good or poor harvest is argued to be directly related to the processes and systems used during pre-cultivation phase".

For over a decade, there have been significant changes in socioeconomic, cultural and political circumstances which have impacted on healthcare systems policies and procedures, However, these have not been adequately reflected in the DGs used for healthcare facilities project development processes (Francis et al., 2001; Hamilton and Orr, 2006). An integrated approach between healthcare systems policies and the DGs used for healthcare facilities projects is lacking, as noted by Okpanum (2002). Indeed, opportunities for learning from DGs and feeding that learning into the planning, design and development of future healthcare facilities have, not been fully utilised.

2.10.2 Users and the influence of effective and efficient DGs

The functional suitability, effectiveness and efficiency of healthcare facilities are significantly influenced by the DGs used for their development. DGs can improve healthcare facilities project development and operational processes, thereby addressing challenges of resources use, capacity efficiency, integration, distribution, attachment and value for money, as several studies confirm (Augustine, 2009; Cama, 2008; Coleman et al., 2007; Hamilton and Shepley, 2009; Kleczkowski and Pibouleau, 1976; 1983; 1985; Pile, 2009; Rengel, 2007).

Users of DGs, however, do not all view them in the same way. Some see DGs as a policing tool, and others as frustrations, without examining the intrinsic reason for their existence—for example, as a tool for implementing healthcare system objectives; as a tool for addressing issues of accessibility, integration, identity, management and satisfaction; or as a tool for advancement of their work 'for the good of all, (Durkheim, 2001; Taylor, 2003).

2.10.3 Community expectation and participatory perspectives

Transformative change that can positively impact on communities' expectations and quality of users' experiences requires culture change through DGs used for healthcare facilities development (Hamilton et al., 2008a). Such change will inevitably involve change in the project briefing approach, design culture, procurement and construction systems, and organisational and operational culture (Hamilton, 2008; Hamilton and Orr, 2006; O'Toole, 1996; Sadler et al., 2008; Schein, 2004; Seel, 2000).

Most studies in the literature argue in favour of the introduction of protocols and tools in DGs to encourage participatory project development processes. In this regard, Gesler (2003:103) believes that:

> "... conceptualisation should be engaged in by a wide variety of actors: architects, administrators, staff, and patients... [that] those involved in implementation must be flexible, constantly open to change and new ideas...[and] that participation by many different groups of people is a key to success in implementation".

There is also consensus in the literature about the importance of understanding all relevant issues in the strategic and briefing protocols and tools in the DGs before engaging in a design process, as this is vital for informed communication systems and effective participation of all the stakeholders involved (Dainty et al., 2006; Guenther and Vittori, 2008; Henriksen et al., 2007; Joint Commission Resources, 2009; Scruton, 2004; Tyler, 2006).

2.10.4 Attitude and behaviour of the stakeholders and value systems

Providing basic information on challenges impacting the healthcare delivery system can influence the attitudes and behaviours of stakeholders. The information systems in the DGs relating to this issue can assist stakeholders in identifying and implementing potential solutions collaboratively that will positively affect the outcome of healthcare services delivery. As explained in Section 2.3 above, an early common understanding can facilitate the development of design interventions and solutions in the initial project development stages through to the maintenance and POE of the facility. As most healthcare systems problems are dynamic in nature, constant feedback is essential to assess the success of the strategic approach adopted and what lessons can be learned (Joseph and Sadler, 2007).

Several studies point to the importance of proactively integrating the goals and vision of the healthcare institution in the design philosophy of the facility (Cowan et al., 1987; Lichtig, 2007; Liker, 2003; Raddall, 1986; Stone, 2008; Stone, 2008b). Understanding and implementing an institution's philosophy, vision, mission, goals and organisational culture through DGs used for healthcare facilities development can bring about change in the attitudes and behaviours of stakeholders (Kiesler and Cummings, 2002; Stichler and Hamilton, 2008). However, bringing together stakeholders from different disciplines and concerns requires them to reach beyond their respective areas of competence and responsibility (Kimball, 2005).

The values underlying the DGs update should be based on improving stakeholders' awareness and understanding of the need to embrace the DGs for design, construction, operations and life-cycle costs of the facility. Indeed, the development of socially responsible DGs based on a social model of healthcare facility design can promote equitable and inclusive access, thereby improving access to healthcare services delivery to underprivileged communities ensure, and also assist in achieving sustainability goals in all fronts. However, as Abbott and Cowan (1989) and Hamilton (2009) caution, awareness of DGs may not necessarily influence positive attitudes of stakeholder towards compliance.

Hence, Alexander et al. (1977) and Jones and Pitt (2009) argue that developing general and specific requirements focused on socio-cultural, political and ethical imperatives, Planetree principles and other issues related to the healthcare systems gain to the society should be the guiding principles for DGs update.

2.10.5 The influence of standardisation on project development and operational processes

The current interest in standardisation of project development processes stems largely from clients' dissatisfaction with the delivery of healthcare buildings (Francis et al., 2001).

> "Standardization is a broad concept, and the term has been used in many different ways in the healthcare industry...Typically standardization has been promoted to increase clinician efficiency...and to improve patient safety by limiting the frequency of adverse events resulting from mistakes" (Reiling, 2006:5)

Standardisation can enable greater predictability in the delivery process, with cost and time savings, in addition to improved end product quality (Hamilton et al., 2008b). However, the implications of standardised project development process are not fully articulated in the design tools (Francis et al., 2001). The question of standardisation thus needs to be fully explored in the DGs update; and more so because stakeholders generally acknowledge that standardisation can help address major challenges related to time, cost and quality of the physical environment currently experienced in healthcare facilities projects development. Another key attraction of standardisation is that POE studies of previous projects provide ample information for improvement of the whole process (Pati et al., 2008a). However, some architects argue that standardisation may limit innovation of the whole project development processes (Chaudhury et al., 2004; Christensen et al., 2000; Hamilton, 2009).

2.11 The influence of DGs on the project development process

The information systems[12] in the DGs used for healthcare facility projects define the approach for design, construction, operation and life-cycle costs to improve the project development process (Sadler et al., 2008), as illustrated in Figure 2.11.

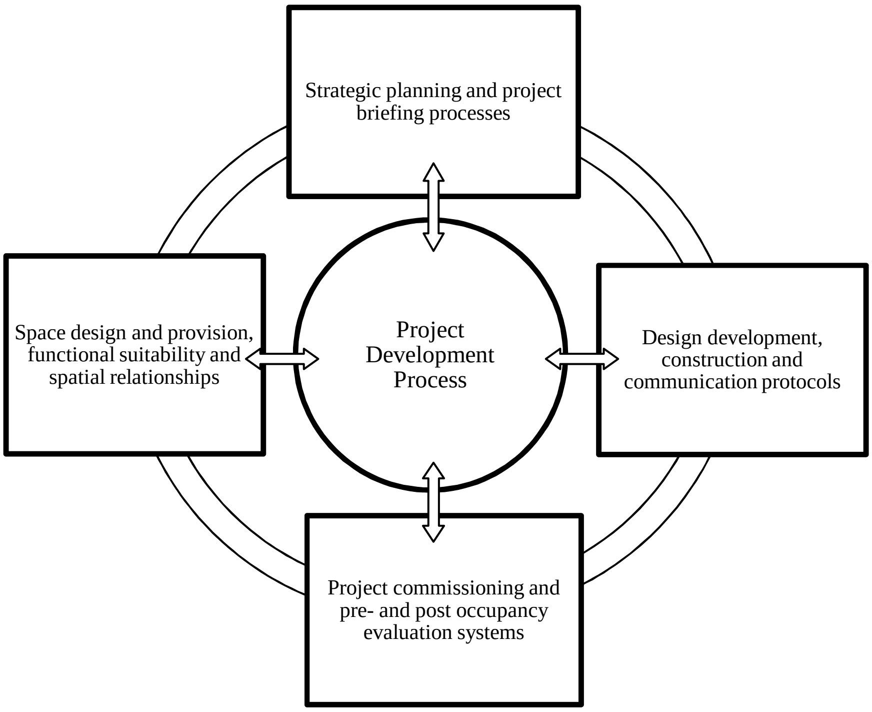

Figure 2.11: The project development process in the DGs

2.11.1 Strategic planning process

Strategic planning aims to create a culture of continuous improvement of the physical environment, innovation and creativity (Hayward, 2006a). It represents the longest perspective the project planning team has for reviewing and evaluating the 30 to 50-year life cycle of the healthcare facility (Palomar Pomerado Health, 2006). Long-term planning evaluation programmes provide information on how well a facility is working in relation to the original goals. The preventative design approach creates opportunities not only for solving

[12] An information system, for purposes of this study, is defined as "*any written, electronic, or graphical method of communicating information*". The basis of an information system is the sharing and processing of information and ideas, which in the case of DGs may refer to specific and general requirements for project briefing, design, procurement, construction, and POE. Computers and telecommunication technologies have become essential information system components that can be used for processing specific and general requirements in the DGs used for healthcare facilities project development process.

problems, but also for anticipating them and providing informed solutions that may be included in the long-term budget (Stichler, 2009).

There is a direct relationship between design tools and capital expenditure; for instance, the DGAEF stress area and cost control. The design team and construction firm thus normally concentrate on minimizing capital expenditure to remain within the parameters set in the DGAEF rather than on running costs. As a consequence, other issues necessary for delivery of efficient, effective and responsive healthcare services to the community receive minimal attention. In spite of the huge investment costs involved, relevant design tools to achieve equity in healthcare facility distribution, such as criteria in the DGAEF to monitor overall project development processes, are yet to be developed through rigorous research.

2.11.2 Project briefing process

The project brief serves two primary purposes: (i) to define how space needs to be configured to promote efficient and effective operational flows; and (ii) to identify the people, processes and technology changes that need to be further developed during the design phase and implemented prior to occupation of the new facility. The space programme lists space and room types and the required quantity of each; required floor area with minimal dimensions as applicable; and any specific requirements with respect to functionality of the room, equipment, staff needs, etc. (The Center for Health Design, 2009).

Three components of A&E facility space design have to be analysed to estimate the total number of examination and treatment rooms required, according to American College of Emergency Physician (ACEP) (2004): demand, peaks and actual time spent in the room for medical attention excluding waiting time. Using the ACEP guidelines, the estimated number of examination and treatment spaces should be calculated by multiplying the expected peak shift workload by the average room time and dividing this figure by eight hour staff shifts, with two more rooms added to the total for resuscitation spaces.

2.11.3 Space design, functional suitability and spatial relationships

The DGs used for healthcare facilities directly and indirectly influence space design and utilisation, and operational processes (Valins and Salter, 1996). The choice of floor plan configuration can have the following space utilisation, functional suitability and operational benefits: effective and efficient circulation system which reduces travel distances; increased workflow predictability; ease of wayfinding for patients/community/ caregivers; less space required for operations resulting in reduced departmental fragmentation and cost savings (Frampton and Charmel, 2009).

Comparative studies have found the traditional “racetrack” floor plan configuration with long corridors to adversely affect caregivers’ operations; and circular and triangular floor plan configurations to be more popular as they enhance caregivers’ workflow processes. The circular floor plan configuration is, however, less flexible and adaptable; requires more floor area per patient accommodation space; and wastes space in caregivers’ areas. The triangle floor plan configuration reduces the overall floor area; but is more cost effective than both the circular and racetrack design solutions, and also more adaptable to different uses and spatial arrangements (Burk and Kurrasch, 2006; Department of Health and NHS Estates, 2004; Francis et al., 2001; Monk, 2004; Prasad, 2008b).

2.11.4 Project development and communication protocols

There is growing recognition of the need for LEAN integrated and collaborative project design and development approaches (Miller and Swensson, 2002). The LEAN project development model can be used to develop the highest quality systems for integrated team communication; increase efficiency in gathering and distribution of critical project information; promote use the most cost effective technological solutions; and enhance flexibility and scalability in project development processes (Dainty et al., 2006; Weitzner and George, 2009; Zambo and Ayers, 2007).

> "LEAN operational approach includes: developing framework for good communication; narrowing gap in communication; using building information modelling (BIM); construction of models and full-scale mock-ups; developing continuous communication protocols; effective and efficient simple filing system" (Zambo and Ayers, 2007:11).

To maximise return on investment and value for money during design, construction and life-cycle costing, a holistic approach needs to be developed through DGs to encourage communication between stakeholders and a culture of learning. To this end, all stakeholders have a responsibility to rethink how to improve communications protocols.

2.11.5 Project commissioning and pre- and post occupancy evaluation systems

The DGs used for healthcare facilities development have an important role in meeting community healthcare needs through continuous improvement of the health systems policies (Kantrowitz, 1993). Pre-occupancy occurs when healthcare institutions take possession of the building from the design team. Facility occupancy occurs when people are allowed inside for healthcare services delivery. POE is conducted after occupancy of the facility, but not necessarily immediately. Indeed, it is advisable to delay POE for six months to a year to allow users to use and assess the facility (The Center for Health Design, 2009).

POE assesses compliance to design requirements such as space design and provision; functional suitability and space utilisation; spatial relationships and internal/external ambience; materials and finishes; aesthetics factors; technical factors; and cost factors (Kantrowitz, 1993). However, few stakeholders carry out POE (Purves, 2002). The inadequate use of POE is partly attributable to insufficient tools in the DGs; and cost is also a constraint.

The Achieving Excellence Design Evaluation Toolkit (AEDET) was developed as a benchmarking tool for evaluating the design of healthcare buildings from initial proposals through to POE. The AEDET toolkit forms part of the guidance for healthcare facility projects in UK, including ProCure21, PFI (Private Finance Initiative), LIFT (Local Finance Initiative

Trust) and conventionally funded schemes (Codinhoto et al., 2008a). The AEDET toolkit has three main sections comprising of ten assessment criteria (NHS Estates, 2001):

(i) impact (character and innovation, form and material, staff and patient environment, urban and social integration);

(ii) build quality (performance, engineering and construction); and

(iii) functionality (uses, access and space).

But according to Hignett and Lu (2008a), the AEDET toolkit provides inadequate information and evaluation systems for design tools (project brief definition, design solutions and project implementation approach); quality of the physical environment (space design, workflow systems, processes and engineering services, quality of materials, finishes and technical performance) and perception (level of satisfaction and quality of services delivery).

2.12 Gaps and limitations in the DGs

Many of the problems evident in the DGs are related to gaps and limitations in their interpretation, translation, application, and infrequent update (Cowan et al., 1987). Studies have linked the traditional project briefing approach, design and construction systems to poor and unsustainable outcomes (Jones, 2008; McDonough, 2004; Mclennan, 2004). Although the sustainability perspective is not analysed in detail in this study, several studies underscore the complexity of the sustainable design perspective, which includes social, political, economic, ecological and health dimensions (Barker, 2002; Lee, 2005; Ornstein and Sobel, 1990; Wilson, 1984; Wilson and Kellert, 1993).

There is now a philosophy that sees design, construction, operation and maintenance of the building as interrelated, interconnected and interdependent components of the project development process; but the tools required to operationalise this new paradigm A&E lacking in the DGs (Huelat, 2003). The PFI approach to healthcare facilities development has produced good results in terms of limiting construction timeframes and project budgets; but allowing construction companies to determine the evaluation approach for design, construction and life-cycle costing of these facilities may not provide good value for money. Furthermore, there is no substantive research basis underpinning the PFI procurement system. The PFI approach may also discourage innovation and change in institutional culture; hence, completed facilities may not respond appropriately to changing needs, and operational and sustainability issues (Monk, 2004; Purves, 2002).

The dropping of the DGs and norms for healthcare facilities through PFI schemes may have a negative impact on healthcare facilities expenditure in the future (Monk, 2004). The structure for control of these important major projects by public sector procurement bodies is indeed still lacking; but completed schemes are being studied for the purpose of establishing good practice procedures (Purves, 2009).

A series of Technical Notes has recently been produced to give guidance on key technical issues that have arisen from the implementation of PFI, which focus mainly on financial, administrative and management procedures, giving prescriptive requirements. Architectural design issues are seen as secondary, as has been the case since the post-war health care buildings (Monk, 2004).

2.13 The conceptual framework for DGs update

Healthcare facilities development is complicated, cumbersome and shaped by a multiplicity of internal and external factors which have significant implications project design and development process and outcomes.

The conceptual framework for DGs update should therefore be seen in relation to the overall healthcare system and healthcare delivery systems. And it should help improve understanding of the issues and challenges related to accessibility; equity in resources distribution; responsiveness; efficiency; effectiveness; and moral, ethical and value systems.

The following six key concepts are identified as influencing and being influenced by the DGs update process:

(i) DGs as a medium of communication;

(ii) the influence of DGs on effective and efficient design of healthcare facilities;

(iii) introduction of participatory approach process in the DGs;

(iv) the importance of DGs on technology innovation;

(v) the role of DGs on institutional transformation; and

(vi) standardisation of the project implementation process and life-cycle costing.

2.13.1 DGs as a medium of communication

DGs should be a common communication medium, facilitating efficient and effective healthcare facility design and development. However, there are no communication, translation, evaluation and feedback tools in the DGs for explaining the vision and desired culture of the healthcare institution (Hamilton, 2009; Nestor, 2009).

Communication and translation: DGs have been developed without comprehensive information systems for communicating and translating context-specific general and specific design requirements relating to design tools, quality of the physical environment and perception or impact (Hayward, 2006a; Hignett and Lu, 2008a). Indeed, they are viewed as counterproductive owing to the use of universal formulae for establishing general and specific design requirements (Abbott and Cowan, 1989). There is inherent danger in using universal DGs as it may be difficult to establish criteria for evaluating contextual differences in epidemiology, services expectation and available resources.

Evaluation: Rigorous evaluation methods in the DGs are essential for continuous monitoring and feedback on whether the vision and desired culture are being met during the project development process. DGs currently focus mostly on area and cost, paying little attention to methods of explanation and evaluation of the general and specific design requirements (Abbott and Cowan, 1989; Hamilton, 2009; Nestor, 2009).

Feedback: Information gathered through qualified research or POE processes is rarely used for developing and updating DGs (Hignett and Lu, 2008a). Therefore, continuous change in current and future healthcare services delivery needs is not reflected in DGs used for healthcare facility projects. (Abbott and Cowan, 1989; Deshmukh and Minnick, 2006).

2.13.2 The influence of DGs on effective and efficient design of healthcare facility

Effective and efficient space design and provision, functional suitability and spatial relationships are influenced by the DGs, which aim to address issues relating to resources use, integration, distribution and attachment (Hamilton, 2008).

Integration: A growing body of literature supports the argument that evidence-based design decisions result in more efficient and effective resource management and improved quality of healthcare services delivery (Hackman and Oldham, 1980; Hamilton, 2008). Several studies also show that integration of engineering services in space design and provision is becoming increasingly more important for improved functional suitability and space utilisation (Hamilton, 2003; 2004; 2006a; b; Rubin et al., 1998; Ulrich et al., 2004).

Distribution: The social model of healthcare focuses on Planetree principles and provides research based information for improving design solutions in order to achieve more equitable distribution. The DGs used for healthcare facility project development processes can positively influence greater equity in distribution (Miller and Swensson, 2002).

Attachment: Sustaining the momentum and progress of a cultural, social and policy transformation process like DGs update is critical yet difficult (O'Toole, 1996). The DGs update process can attract interest if its importance in relation to the improvement of the healthcare system is properly understood. But while people may want to participate in a new process receiving a lot of attention, that can easily wane, especially if the process is not well managed (Kotter, 1996; O'Reilly and Pfeffer, 2000).

2.13.3 Introduction of participatory processes in the DGs

DGs should encourage the participation of all key stakeholders, and should also establish a common vision, mission and learning objectives (Carpman and Grant, 1993).

Identity and obligation: Studies have found that that people have different expectations regarding government’s obligation to improve healthcare systems; but users want to be involved in decision making regarding the design of the healthcare facilities they use (Pena et al., 1987; The Center for Health Design, 2009). Indeed, people are increasingly insisting on participating in decision making on issues that affect them (Pena et al., 1987; Valins and Salter, 1996; Wilkins and Ouchi, 1983).

Influence: Understanding users’ needs and expectations can improve their perceptual view of the space design and provision of healthcare facilities. In this regard, DGs used for their development can anticipate and avert errors that could result in costly additions and alteration works, as is frequently the case with newly completed healthcare facilities (Miller and Swensson, 2002). For example, Nelson Mandela Teaching Hospital and Pretoria Academic Hospital in South Africa, completed in 2002 and 2007 respectively, required costly modifications before opening as they had limited participatory design processes embedded within them (Okpanum, 2003). Users’ satisfaction is positively influenced by an egalitarian philosophy that removes barriers to participatory processes.

2.13.4 The importance of DGs on technology innovation and update

The DGs used for healthcare facility design should integrate technology innovation into the healthcare facility development process as they are interrelated, interdependent and interconnected. The DGs should also promote interaction of the interdisciplinary team which technology innovation demands. Indeed, the interdisciplinary team must work together in addressing issues relating to design, procurement, resources use, operations and maintenance (Bijker et al., 1989).

Adaptability and management: DGs development and update processes can benefit from today's technology, information systems and communication innovation for healthcare facility space design and provision (Barlow, 2008; Bijker et al., 1989). For example, the DGs for acuity adaptable patient room space design articulate general and specific design requirements that allow for future space flexibility and adaptability; accommodate technology innovation and changes in workflow and management processes; and provide a supportive environment for improved healthcare service delivery (Debajyoti et al., 2009c).

Resource management and procurement: Healthcare facility development requires addressing complex issues through procurement and management of resources (Monteleoni, 1991). In this respect, benchmarking tools can lead to significant reductions in unnecessary waste, construction time, and overall project costs (Mulva and Dai, 2009) but they are lacking in the DGs (Kahn, 2009b).

2.13.5 The role of DGs on institutional transformation

DGs can play an important role in encouraging institutional transformation in the areas of accessibility, operational processes and quality of care.

Accessibility: Studies show that the value attached to physical, social and emotional needs by users are related to the choice of space design solutions, which influence institutional transformation (Hamilton, 2008; Sadler et al., 2008; Ulrich et al., 2004). For example, accessibility and wayfinding problems in healthcare facilities are stressful and have a negative impact on users, who are often unfamiliar with the physical environment (Ulrich et al., 2004; Valins and Salter, 1996); and also impact negatively on institutional performance.

Operational processes and quality of care: Significant improvements in operational processes and quality of care can be achieved through the general and specific requirements in

DGs, by improving performance with respect to HAI, medical mishaps and errors, average length of stay, privacy and dignity and social support spaces (The Center for Health Design, 2009). However, DGs typically lack comprehensive design tools for addressing these challenges. However, DGs based on the Planetree philosophy would require a relatively modest cost increase of about 5% of the overall project cost to implement, and would positively impact on operational processes and quality of care, as well as attitudes and behaviours of stakeholders which influence institutional transformation (Hamilton, 2008).

2.13.6 Standardisation of the project development processes and life-cycle costs

Standardisation, as explained in detail in Chapter 2.10.5, can enable greater predictability in the delivery process and improved end product quality by addressing issues related to: quality; time; cost; aesthetics and performance.

Quality, time and cost: The traditional approach to healthcare facility development projects typically results in unsatisfactory outcomes owing to long delivery timeframes, poor end-product quality and cost overruns (The Center for Health Design, 2009). Gropius' (1965) ideas of over 50 years ago of the need to integrate design into the construction industry through standardisation of the whole process are now been considered in most developing countries. But even as standardisation of design and construction systems continues to evolve and be adopted, it is yet to be included in the DGs (Francis et al., 2001; Prasad, 2008b; The Center for Health Design, 2009).

Aesthetics and performance: Standardisation is capable of generating simple project development systems to ensure replicable good practice in design and construction, in addition to providing performance, quality and aesthetic standards for healthcare facility design based on tested and agreed frameworks (Francis et al., 2001; Kahn, 2009b). Empirical studies on standardisation of space design support flexibility, adaptability and choice in workflow processes through the development of generic and interchangeable room types, resulting in increased throughput. Furthermore, reduction in staff stress as a result of an improved work environment can result in measurable positive outcomes on patient safety issues and work satisfaction (Debajyoti et al., 2009c; Francis et al., 2001; Ulrich et al., 2004).

2.14 Emerging themes from the literature review

From the foregoing review of the literature, it is possible to identify key emerging themes that are of particular relevance to the DG update. These are: design tools/project development process; quality of the physical environment; and perception or impact. As illustrated graphically in Figure 2.6, these themes are directly related to desired project development process outcomes with respect to space design/ provision; functional suitability/ space utilisation/ spatial relationships; and user satisfaction.

2.15 Proposed conceptual framework for DGs update

The focus of this chapter has been to explore, understand and gain knowledge on the socio-econo-political, cultural and technological issues that impact the role and performance of DGs for healthcare facilities development. In addition, the literature review provided important and relevant information relating to patient demographic data, needs analyses, space programming and also how to link project goals, desired project development process outcomes. Studies drawing from these perspectives suggest that theoretical models are an important tool for investigating the role of DGs for healthcare facilities projects. Indeed, the theories and design philosophies behind healthcare facilities development from the early ages to date underscore the need to identify and explore methodologies for evaluating project development process tools, quality of the physical environment and perception (impact).

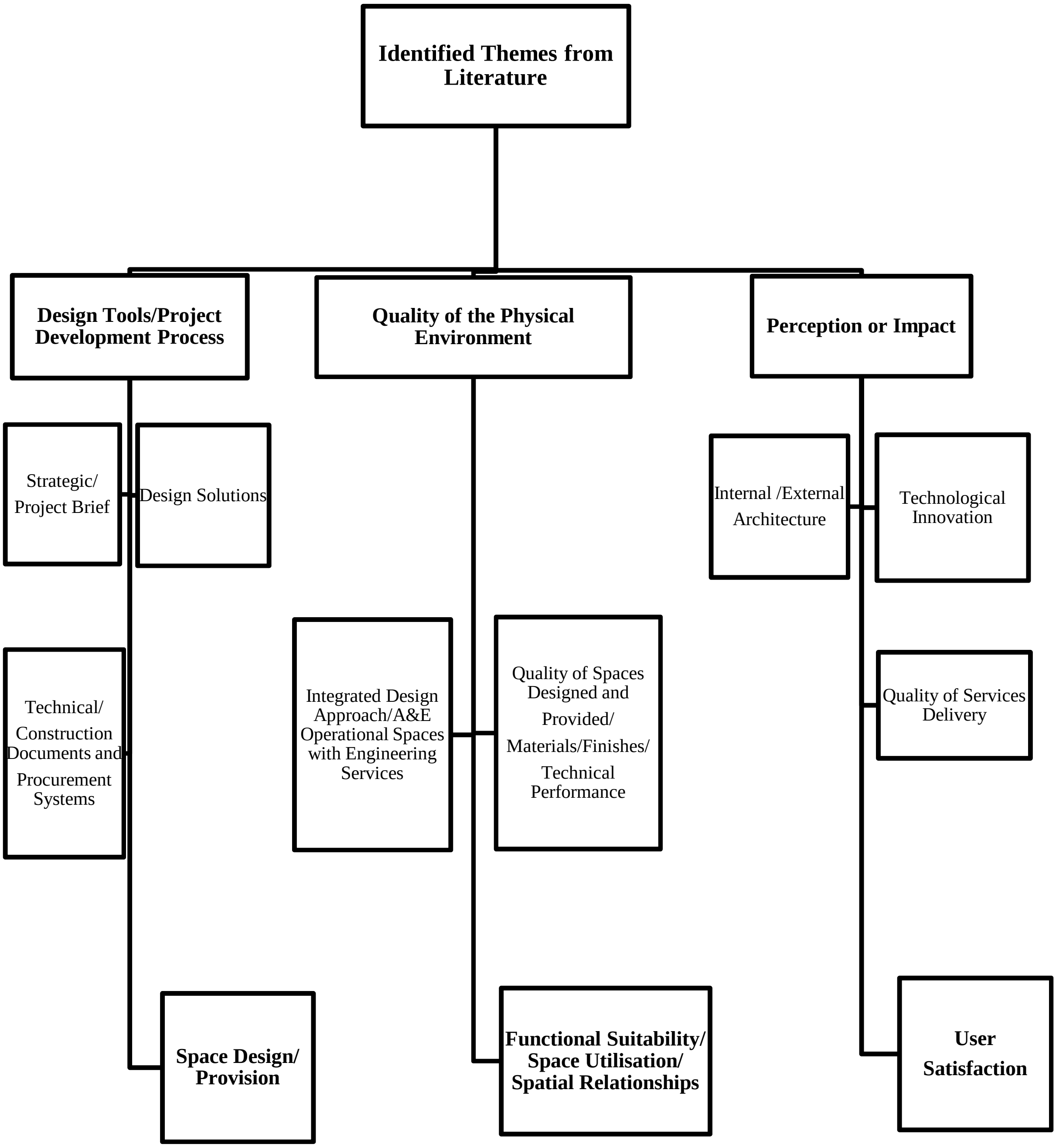

Figure 2.12: Emerging themes from the literature review

Informed by the foregoing literature review, the conceptual framework proposed for this study identifies six significant conditions that influence and are influenced by the DGs update. These conditions represent the practical realities of DGs, quality of the physical environment and stakeholders' perceptions of healthcare facility development projects, in both developed and developing countries. The key concepts that make up the theoretical framework and operational context are:

(i) DGs as a medium of communication;

(ii) the influence of DGs on effective and efficient design of healthcare facilities;

(iii) introduction of participatory approach process in the DGs;

(iv) the importance of DGs on technology innovation;

(v) the role of DGs on institutional transformation; and

(vi) standardisation of the project implementation process and life-cycle costing.

These are illustrated in the proposed model of the conceptual framework for DGAEF update in Figure 2.7 below, and provide the basis for the empirical research, data analysis and discussions in the following chapters.

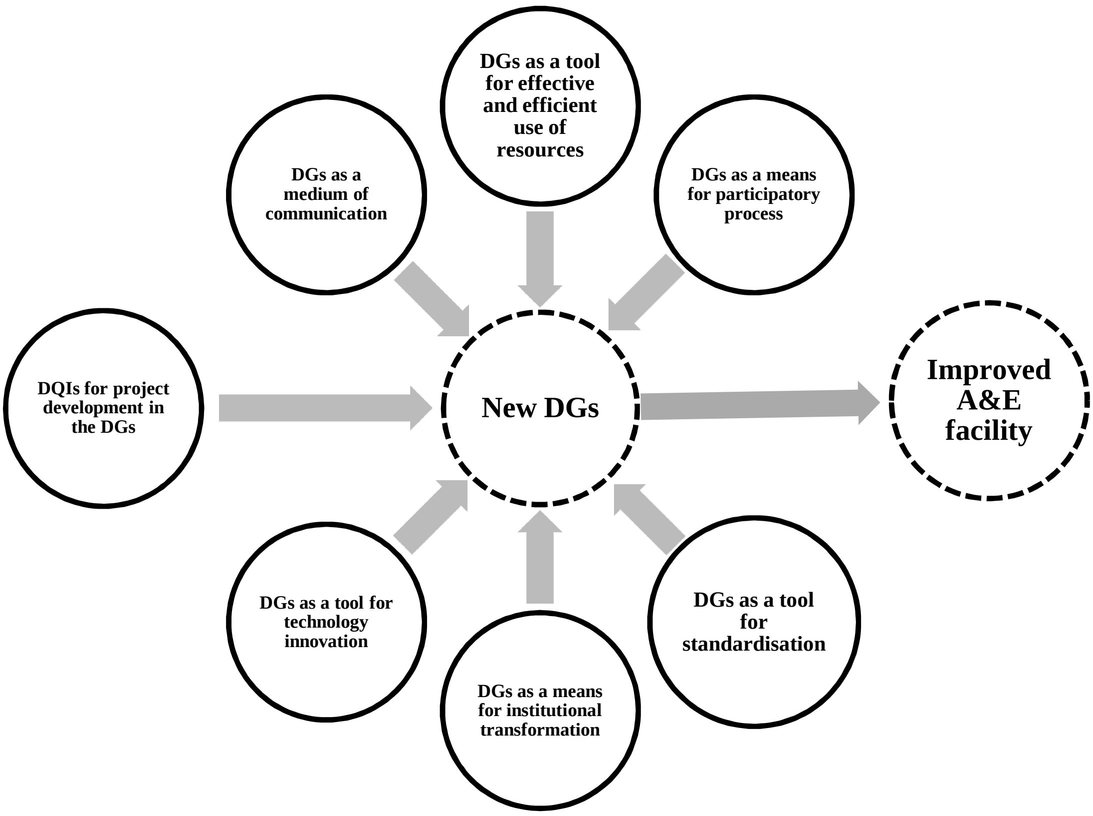

Figure 2.13: Proposed model of the conceptual framework for DGAEF update

2.16 Summary and conclusion

The process through which healthcare services are delivered has evolved significantly over time, having been subject to change due to myriad forces ranging from medical and technological innovations to socio-economic and political influences. Hence, the healthcare services delivery process has evolved into an ambitious operational system using large, technologically advanced healthcare facilities. But this has resulted in failure to deliver services punctually and within budget, giving rise to wide-ranging reviews of the healthcare services delivery process and the DGs for healthcare facilities development.

The evolution of DGs for healthcare facilities has thus seen a paradigm shift in response to evolving physical, intellectual and emotional needs of patients for a supportive environment and human relationships and a sense of control over their lives and an opportunity for meaningful participation. There is now broad consensus that the design, construction and procurement of the new generation of the healthcare facilities should be based on Planetree principles, to address challenges related to the project development process, quality of the physical environment and perception.

The theories and design philosophies behind healthcare facilities development from the early ages to date underscore the need to identify and explore methodologies for evaluating the three key themes emerging from the literature review which are of particular relevance to the DG update—design tools/project development process; quality of the physical environment; and perception or impact. The conceptual framework for DGs update should therefore be seen in relation to the overall healthcare system and healthcare delivery systems. And it should help improve understanding of the issues and challenges related to equity, efficiency, effectiveness and responsiveness; and moral, ethical and value systems.

The evolution of DGAEF in South Africa, and the implications of their interpretation, translation and application are discussed in the following chapter.

3 CHAPTER THREE

THE CONTEXT OF THE STUDY, HEALTHCARE SYSTEMS AND ACCIDENT AND EMERGENCY FACILITIES IN SOUTH AFRICA

3.1 Introduction

This chapter presents the context of the study, Gauteng Province, South Africa, shown in Figure 3.1, where the two case study A&E facilities—Chris Hani Baragwanath Hospital (CHBH), Soweto, Johannesburg and Pretoria Academic Hospital (PAH), Pretoria—are located. The current statuses of the healthcare system and A&E facilities are explained, and the direct and indirect role that DGs play in their development highlighted. The chapter has three main sections: Section A presents the research context; Section B explores the history and development of the healthcare system; and Section C discusses the evolution and effect of the DGs in the development of A&E facilities in South Africa.

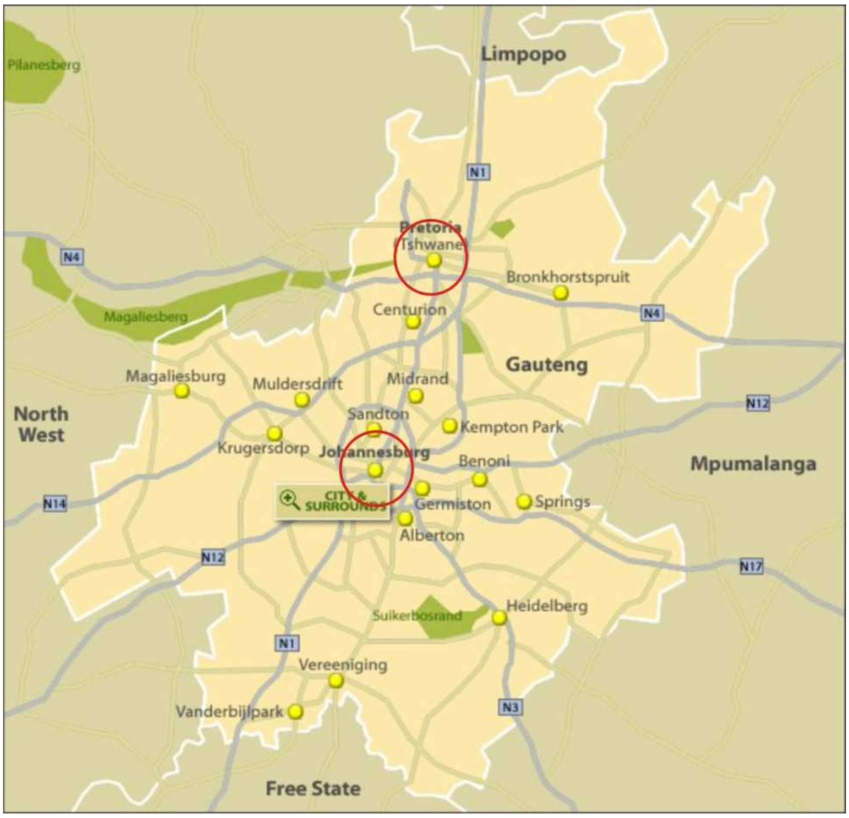

Figure 3.1: Map of Gauteng Province in South Africa

A THE RESEARCH CONTEXT

The study of A&E facilities in South Africa needs the consideration of its geographical, political, ideological, social and economic background.

3.2 Geographic and climatic context

The 25th largest country in the world, South Africa has three main geographic regions: a great interior plateau; an escarpment of mountains ranges that bounds the plateau on the east, south and west; and a secondary area lying between the escarpment and the sea (Thompson, 2009). It is bordered by the Atlantic Ocean on the west and the Indian Ocean on the south and east. Namibia, Zimbabwe and Botswana border the country to the north, as Figure 1.1 shows.

The country's geographical location in the milder southern hemisphere, and its being surrounded by the two oceans means that South Africa generally has a temperate climate. However, because of the varied topography, the east coastline has a tropical microclimate, while the sparsely populated Karoo region in the west is dry. The southwest regions have a Mediterranean climate, characterised by hot, dry summers and mild, wet winters (Thompson, 2009). The climatic context influences space design and provision in healthcare buildings; and is, thus, a critical issue for consideration in the DGs.

3.2.1 Nine main provinces

During the apartheid era, 14% of the country's land was set aside for Africans, in pseudo independent territories known as "Bantustans" or "homelands". This was allegedly to allow them self-government and cultural preservation. The homelands were, however, used to give the white government greater control and exclude blacks from the political system. Thus, prior to the first multi-racial democratic elections in 1994, there were only four provinces in South Africa: Cape Province, Natal, Orange Free State and Transvaal.

Following the elections, black homelands were abolished, and nine provinces created: Eastern Cape; Free State; Gauteng; Kwazulu-Natal; Mpumalanga; Northern Cape; Limpopo; North West and Western Cape. There are three dominant provinces, namely Gauteng; Kwazulu-Natal and Western Cape (Butler, 2009).

Gauteng Province: With only 1.4% of the total land area, Gauteng is by far the smallest province geographically. The population of 10.43 million people constitutes 21.4% of the country's total. Gauteng was built on the wealth of gold—the province has 40% of the world's gold reserves, and contributes 33% to the national economy and 10% to the GDP of the entire African continent (Bond, 2000). It has the highest per capita income level in the country, and is home to some of the most important healthcare facilities in the country, including Chris Hani Baragwanath Hospital in Soweto, the biggest healthcare facility in the southern hemisphere (Butler, 2009; Thompson, 2009).

The provincial capital, Johannesburg, a single municipality covering over 1,645 km^2 and extending uninterrupted east-west through several towns, is by far the biggest city, not only in the country, but also Africa. Johannesburg is also South Africa's economic capital. Pretoria, the administrative capital, is located in the north and is slowly merging with Johannesburg. South of Johannesburg is Soweto (South West Township), developed as a dormitory township for the black people under the apartheid system. With a current population of over 2 million people, Soweto was the strong hold for the liberation struggle against the apartheid system (Butler, 2009; Davenport, 1991).

3.3 Political system

South Africa's apartheid past and subsequent political system has significantly influenced government policies, the healthcare system and healthcare facilities development.

3.3.1 Government and political system

South Africa's first democratically elected government, which came to power in 1994, inherited a rather contradictory legacy. On the one hand, it inherited the most developed economy in Africa, with modern physical and institutional infrastructure. But on the other, it inherited major political, socio-economic and cultural problems, especially within the previously underprivileged black communities, including high levels of structural unemployment; 50% of the population living in abject poverty; high levels of crime and violence; and inadequate provision of healthcare facilities (Buhlungu et al., 2006; 2007; Butler, 2009; Daniel et al., 2005; Feinstein, 2007; Kagwanja and Kondlo, 2009; Ndulu et al., 2008; Pottinger, 2009; Seekings and Nattrass, 2006; Terreblanche, 2005; Thompson, 2009).

The African National Congress (ANC) government that came into power in 1994 was committed to alter the socio-economic landscape within the shortest possible time. While it had a potentially good policy framework, it was ill-equipped to govern. The legacy of the apartheid system was found in all spheres of government, which meant reforming the state to include the black majority who had previously been excluded from participation. New policies, thus, had to be enacted to ensure a balance between the need for rapid change to meet the demands of a majority that had been excluded from state benefits, and the need to maintain loyalty to the state from dominant elements within the state (Leftwich, 1991; Lipton, 1985; Lodge, 2002).

The migrant labour system that existed during the apartheid era was later transformed into a strategy for maintaining a spatially and socially segmented society, with some people having no rights to political inclusion on societal issues, partial or full economic participation, and access to social benefits like healthcare. Thus the transition from white minority rule to a representative democracy faced serious political challenges (Kriger and Zegeye, 2001). The ANC-led government, while struggling to consolidate the multiracial political, democratic system and exert its authority in matters of state, had to contend also with the viability of the new democracy threatened by bureaucratic incapacity and an unstable and unskilled labour force (Nattrass and Seekings, 2001).

All these issues constrained government efforts to de-racialise the system and alleviate the widespread poverty and social deprivation inherited from apartheid. As it emerged, the apartheid system left a worse legacy than was realised in 1994; hence the centralised management style instituted by Thabo Mbeki’s government—seen as the best option at the time. It was, however, criticised by the South African Communist Party (SACP) and Congress of South African Trade Union (COSATU) because, besides generating a high growth rate, it also perpetuated poverty and inequality (Johnson and Schlemmer, 1996). Nonetheless, the ANC-led government has, since 1994, passed unprecedented legislation and policies through Parliament, National Council of Provinces and other levels of government (Johnson and Schlemmer, 1996; Marias, 1999; Nattrass and Seekings, 2001; Rich, 1994; Seekings, 2007).

3.3.2 Government development policies, strategies and plans

South Africa’s unemployment and inequality levels are among the highest in the world (Allen, 2000). How to address this concern without compromising economic growth was thus one of the most important questions raised at ANC's National Conference in Polokwane in December 2007. The Conference recommended development of guidance for an appropriate mix of participatory and representative democratic approaches, the political product of which would be a human-oriented development process (Friedman, 2006; Parsons, 2009).

Evidence shows that strengthening the participatory character of the political system has often provided voice for the poor. Hence the 'democracy mix' between representative and participatory elements of democracy was meant to enhance accountability of the political “elites” to the citizens and facilitate more public discourse in ANC policies in order to realise human-oriented development (Friedman, 2006; Habib, 2008). A human-oriented development policy and planning agenda was thus adopted at the 2007 ANC Polokwane conference; the implementation of which remains a top government priority (Sylvester, 2009).

The 1999 Green Paper on National Strategic Planning (Republic of South Africa, 1999) aims to enhance government planning and co-ordination, with the overall intent of achieving united action on development goals. It proposes the creation of three new planning institutions: a National Planning Commission (NPC) consisting of external commissioners; a Ministerial Committee on Planning to provide guidance and support to the planning function; and a National Planning Secretariat (NPS) to support the work of the commission.

The NPC will develop four main documents. The first is the long-term plan, *South Africa Vision 2025*, which spells out where South Africa wants to be as a society in 2025. The second is the *Medium Term Strategic Framework for 2009–2014: Together Doing More and Better*, which identifies priorities and a few key programmes for the five year term of office of the Government, and which will be reviewed annually. The third focuses on defining key performance indicators, monitoring and evaluation systems to ensure effective implementation and accountability. The fourth is the draft framework for spatial planning, aimed at coordinating government action and alignment; which will focus on, *inter alia*, addressing issues related to the racialised spatial planning and healthcare system inherited from the apartheid era (Republic of South Africa, 1999; Sylvester, 2009).

3.4 Social background

South Africa is characterised by a complex historically racially-racially based socio-political and economic structure.

3.4.1 Population and languages

Population characteristics: The current population of South Africa, based on demographic data obtained from Statistics South Africa (2009) and annual mid-year estimates in July 2009, is 49.32 million. Africans are in the majority at 79.30% (39.1 million), while the white population is estimated at 9.1% (4.4 million). The coloured population is estimated at 9% (4.4 million) and the Indians or Asian population at 2.6% (1.2 million). Females constitute

52% of the population (25.45 million) and males 48% (23.87 million). The average life expectancy at birth is 53.5 and 57.2 years for males for females respectively. This is within the range for developing countries, despite the high national HIV prevalence rate of 29.3% (Department of Health, 2010)

Language characteristics: According to the democratic Constitution enacted in 1996, South Africa is a multilingual country. There are eleven official languages—English, Afrikaans and nine indigenous ones—Zulu, Xhosa, Tswana, Sotho, Swazi, Venda, Ndebele, Pedi, and Tsonga. The national and provincial government may use any of the official languages for government purposes (South African Government, 1996). Most South Africans are multilingual, speaking both English and Afrikaans; but people tend not to have much ability in indigenous languages. Afrikaans is the first language of 60% of the whites and the majority of those of mixed race; while IsiZulu (Zulu) is spoken by 25% of the population (Vail, 1989). However, English is the *lingua franca*, and the main language for official communication and documents, including the DGAEF.

3.4.2 Apartheid racial segregation

The ideology of apartheid was formulated during the first decade of the 20th Century to legitimise a variety of segregationist measures that were already in place. Segregation was a restrictive legislative system that sought to legitimise social differences and inequality in every aspect of life in South Africa. As a socio-economic system, segregation comprised territorial separation of the races in rural and urban areas, as well as in social, political, educational, economic, and legal arenas (Beinart and Dubow, 1995; Dubow, 1987).

Under the Group Act of 1950, the apartheid government divided urban areas into zones based on racial profiling—White, Indian, Coloured and Black—where members of one specified race could live and work (Beinart and Dubow, 1995; Buhlungu, 2006). The Whites, comprising Afrikaans and English speaking communities, subsequently formed the single largest nation in the country, despite being the minority. The state was consequently not obliged to use the same parameters for providing facilities for the subordinate races—the majority blacks, coloureds and Indians. This was a primary aspect of what became a politico-administrative crisis in the late 1990s, requiring new policies for social infrastructure development in ex-Bantustan urban areas—in particular healthcare facilities.

The segregationist legislation applicable to black labour was aimed at guaranteeing an adequate supply of cheap labour on the one hand; and as a method of labour discrimination for protecting white labour against competition from already cheap and docile black labour on the other (Cell, 1982). The same discriminatory legislation was applied in the healthcare environment. For example, the DGs used for healthcare facilities development in the white areas produced better buildings, at the time, than the ones used for developing similar facilities for other racial groups areas (Beinart and Dubow, 1995).

3.4.3 Social inequality and deprivation

Population growth in urban areas is highest among the low income black majority, who are unable to afford even basic formal housing and are consequently forced to live in slums and informal settlements, many of which lack basic infrastructure and social services, such as healthcare facilities (Picard, 2005). Over 63% of the black population live in overcrowded conditions in one-room dwellings in slums and informal settlements. Living in such conditions with no provision for safe water and sanitation services is associated with dramatic increases in death from diarrhoeal diseases and other infectious diseases. Overcrowding also contributes to the spread of diseases, as well as having a negative effect on mental well-being (Kallaway, 2002). The extent and depth of political and socio-economic disempowerment called for political intervention to redress racial inequality in access to resources and services (Ramaphosa, 2004).

The new government has managed to address considerable challenges associated with socio-econo-political factors and profound inequality (Parsons, 2009); neutralising potential conflicts, defusing racial and ethnic tensions, and disciplining potentially anti-democratic leaders (Christopher, 2001). There has also been a drastic reduction in politically motivated violence and territorial conflict (Parsons, 2009). There is now more emphasis on the rule of law, in accordance with constitutional rights, and the use of non-democratic means to achieve systemic or personal goals has been minimised. More importantly, there is now the political will for the use of participatory processes at all levels which can potentially minimise political and social conflicts.

3.5 Economic background

South Africa's historical economic context has significantly influenced the healthcare system and development of healthcare facilities.

3.5.1 Economic characteristics

The ANC government inherited an economy with high levels of public debt, inflation and poverty (du Toit and van Tonder, 2009). However:

> "The disciplined fiscal and monetary policy framework adopted for the economy within the first decade of post apartheid period was able to record significant international growth rates. However, currently, the economic landscape is a daunting task for the government due to global economic circumstances (Nattrass, 2003:54).

Indeed, many observers argue that government policies in favour of the previously marginalised population have not translated into improvement of their socio-economic status (du Toit and van Tonder, 2009; Nattrass, 2003). According to them, reducing the high unemployment rate and improving poverty, health, education, literacy and other indicators of the well-being of the poor, such as access to healthcare facilities, remains a major challenge for the present government.

3.5.2 Economic policies and access to healthcare facilities

The high unemployment rate is attributable, in part, to the tight orthodox neo-liberal policies and programmes adopted by the ANC government. They include the Reconstruction and Development Programme (RDP), the Growth, Employment and Redistribution (GEAR) strategy, and Black Economic Empowerment (BEE). These initiatives were aimed to lower inflation, reduce debt and the inherited budget deficit, and attract Foreign Direct Investment (FDI). This would enable government to adopt a more expansionary fiscal stance in the form of increased levels of public expenditure, in particular on social infrastructure and reduction of the interest rate and tax burden (Nattrass and Seekings, 2001).

FDI has not responded as quickly or extensively as hoped; but private sector investment has grown moderately, at about one-tenth of the rate predicted, owing to the slow response from the private sector, which is beyond government control (Nattrass, 2003). The government may, however, have contributed to employment losses by continuing with trade liberalisation in the absence of labour market reforms. Apartheid education policies are also argued to have adversely affected the potentially productive population (Daniel et al., 2005).

The high growth rate favouring wealth creation in the formal sector has contributed to a rise in the Gini coefficient,[13] which reflects an increasingly skewed distribution of income, as illustrated in Figure 3.2. Findings from a longitudinal study conducted by the University of South Africa, Pretoria on income distribution show that the Gini coefficient increased from 0.57 in 1992 to almost 0.70 in 2008. It can thus be inferred that the first economy, which includes the black middle class, benefited more from the higher growth rate than the poorer population in the second economy. The high unemployment rate and increasing Gini coefficient is evidence of the limited capacity of the economy to absorb more labour and reduce the skewed income (du Toit and van Tonder, 2009; Seekings and Nattrass, 2006). One of the key elements in the economic policy to reduce unemployment amongst the low skilled population is investment in social infrastructure, including healthcare facilities, particularly through government spending (Abedian and Ajam, 2009; Gelb, 2005).

The above findings support Abedian and Ajam's (2009) argument that the need for radical upgrading of South African social infrastructure is urgent and beyond debate. Indeed,

[13] The GINI coefficient measures income inequality on a scale from 0 (indicating perfect equality) to 1 (indicating complete inequality).

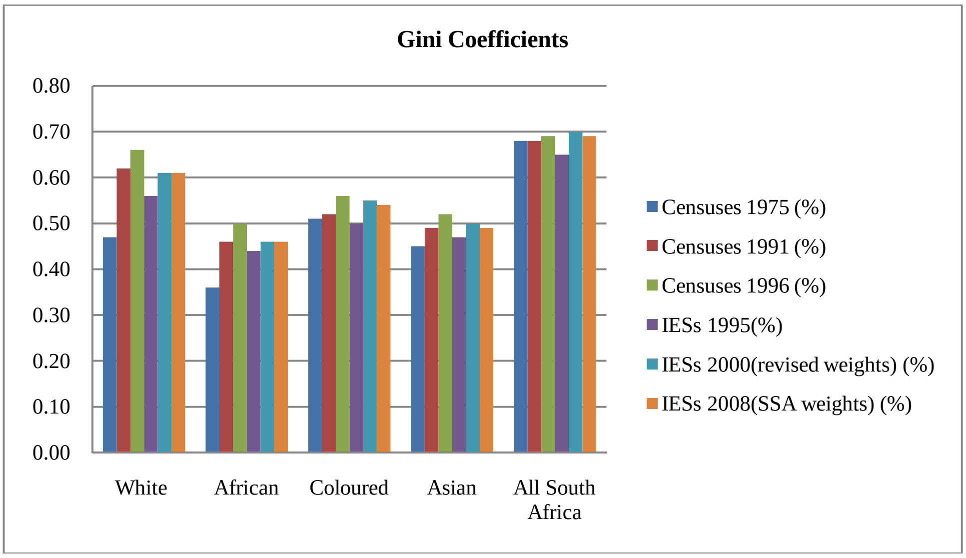

Figure 3.2: Gini Coefficients for the distributions of the household income 1995-2008

Source: University of Pretoria Statistics Department, 2008

certain communities have taken to the streets to demonstrate against the lack of quality services, and their continued degeneration when they are available. Since the ANC government came into power in 1994, public sector capacity for policy implementation has proved to be inadequate. Hence, despite a significant increase in government spending on healthcare since 1995, as shown in Table 3.1, there has not been a reduction in the healthcare facilities backlog. The latter, is due in part, to the continued use of outdated DGs developed by the apartheid government, in particular for the development of social infrastructure and facilities in the health and education sectors. This is one of the greatest risks in the South African socio-econo-political landscape (Abedian and Ajam, 2009).

Table 3.1: Provincial healthcare system spending in rand per billions 1995-2007

Provincial health spending patterns in R billions, 1995-2007	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2006**	**2007**
Eastern Cape	2,206	3,066	3,031	3,048	3,496	3,790	3,992	4,493	5,242	5,173	6,122	7,658
Free State	1,183	1,470	1,659	1,692	1,654	1,777	1,953	2,194	2,563	2,797	3,099	3,470
Gauteng Province	3,092	4,643	5,299	5,478	5,805	5,942	6,838	7,685	6,190	8,597	9,973	11,011
KwaZulu-Natal	2,385	4,234	4,806	4,900	5,110	5,772	7,033	7,535	8,343	8,950	10,517	12,796
Northern Province/ Limpopo	1,424	1,999	1,954	2,081	2,221	2,524	2,664	3,166	3,724	4,196	4,790	6,912
Mpumalanga Province	541	817	1,047	1,058	1,147	1,117	1,457	1,689	2,007	2,263	2,654	3,194
Northern Cape	277	330	376	392	433	466	517	609	833	832	1,098	1,401
North West	933	1,276	1,375	1,342	1,384	1,561	1,699	2,012	2,263	2,595	2,957	3,778
Western Cape	2,346	2,780	2,937	3,032	3,125	3,468	3,731	3,984	4,597	5,172	5,707	6,774
Total	16,097	20,615	22,484	23,023	24,375	26,417	29,884	33,367	35,762	40,575	46,917	56,994

Source: Statistics South Africa 2007

B HEALTHCARE SYSTEM

The ANC government, when it assumed power in 1994, found a plural healthcare system divided into two parallel sectors—a public sector financed by the government; and a private sector funded through medical aid, largely serving the white minority population. The healthcare system was disorganised, with emphasis towards a specialist based system, and the management of resources was ineffective and inefficient (Schneider et al., 2007). The result was a highly inequitable, expensive and inefficient system (Akinboade et al., 2009). The government has thus adopted numerous policy initiatives to transform the healthcare system.

3.6 National healthcare policy

The Declaration of Alma-Ata (WHO, 1978) called on all governments to formulate national policies, strategies and plans of action to launch and sustain primary healthcare as part of a comprehensive national healthcare system. And in 1979, WHO issued guiding principles for formulating strategies for achieving the goal of 'Health for All by the Year 2000' (WHO, 1979). This was enshrined as a right in the 1996 South African Constitution so as to ensure that all citizens have access to quality healthcare services (RSA, 1996).

The "White Paper for the Transformation of Health System in South Africa", published in 1997 (Department of Health, 1997) was developed within the framework of the Reconstruction and Development Programme (RDP). It proposes a national health policy based on the primary healthcare (PHC) approach; a unified national health policy integrating the public and private sector; the development of a district system; the reduction of inequalities; and expanding access to essential healthcare services to all citizens (Schneider et al., 2007). It also presents a set of policy objectives and principles upon which the Unified National Health System of South Africa will be based, as well as various implementation strategies designed to meet the needs of the population with the limited available resources.

The White Paper was used as a basis for the South African National Health Act, No. 61 of 2003 (Republic of South Africa, 2004), the main aim of which is to regulate national health and provide healthcare institution policies that will enhance equity,[14] efficiency,[15] effectiveness[16] and responsiveness[17] in delivery of healthcare services (Department of Health, 1997).

3.7 Organisation and structure of the healthcare system

The healthcare sector has, since the beginning of the ANC led government, undergone significant change to make the healthcare system more equitable and accessible to the poor. The policy of universal access to PHC forms the basis of healthcare delivery programmes. Hence, in undertaking a comprehensive reorganisation of the highly fragmented and bureaucratic system, the new government sought to focus on PHC for healthcare services delivery in a number of ways. They include developing and implementing a PHC facilities building and upgrading programme in which a considerable number of new clinics were built and upgraded; and removing user fees for public PHC and all fees at larger healthcare facilities for pregnant women and children under the age of six years (Akinboade et al., 2009; ANC, 1994a; 1994b; Bloom and Canning, 2003; Ntsaluba and Pillay, 1998; South African National Department of Health, 1997). The new government has thus been able to achieve reasonably good results in social infrastructure facility development in some provinces, and in particular in Western Cape Province (Schneider et al., 2007).

[14] Equity in healthcare services delivery can be achieved, it is argued, if the healthcare system policy focuses on developing PHC (A&E) facilities as there is evidence that expenditure in this sector is more pro-poor than focusing resources on developing specialist healthcare facilities. Furthermore, studies from developed countries demonstrate that an orientation towards specialist healthcare facilities reinforces inequality in access to the healthcare system (WHO, 2004).

[15] Efficiency measures are quantifiable and are directly related to designs that will improve completion times for workflow processes as well as financial savings (Prasad, 2008).

[16] Effectiveness measures are indirect, depending on the healthcare institution’s services delivery culture, business goals and the community needs; but they should address the triple bottom line for sustainable building—social, economic and environmental factors (Prasad, 2008).

[17] Responsiveness: greater investment in PHC (or A&E) facilities, because of their gate-keeping function, increases access to the healthcare system with associated lower morbidity and mortality. Improved access to these facilities also has added benefits such as reduced average length of stay in healthcare facilities; less utilisation of specialist healthcare facilities; and less chance of being subjected to inappropriate healthcare intervention (WHO, 2004).

The White Paper on Health introduced a three-tier healthcare system: Level-1 (L1) primary healthcare; Level-2 (L2) secondary level of care; and Level-3 (L3) tertiary or specialist level of care. Level-1 facilities include district healthcare facilities, clinics, community mobile or fixed healthcare centres, family and homecare. Level-2 facilities are regional and referral healthcare facilities. Level-3 facilities comprise tertiary and other academic healthcare facilities (Department of Health, 1997).

However, the challenge of adequate provision of healthcare facilities still remains owing to inefficient use of available resources (Akinboade et al., 2009). This is confirmed by the findings of the WHO (2000a) report, based on the following performance indicators: equity, efficiency, effectiveness and responsiveness. This report ranks South Africa 175th out of 191 member states in terms of the quality of healthcare services delivery (WHO, 2000).

3.8 Health information and statistics

Healthcare information systems suffered the same fragmentation as the healthcare system during the apartheid era. A review by the ANC government in 1994 found multiple incompatible information systems in existence in the public healthcare sector which needed to be substantially reviewed and standardised before any national health information system could be established. Furthermore, most did not provide sufficient information to enable coherent planning decisions. They were designed for budgeting and personnel management purposes and thus did not provide information related to health status and healthcare services delivery to the population (Bradshaw and Mbodo, 1995; Heunis, 2004).

During the apartheid era, government healthcare clinical research was conducted in the government-owned Medical Research Council and tertiary facilities. The research was basic and clinically oriented, with little public health and even less healthcare systems content. Health statistics data was collected only from the minority, with limited institutional information systems to support planning, design, construction and operation of healthcare facilities (Andrews and Pillay, 2005; Bloom et al., 2004; Heunis, 2004; Van Rensburg, 2004).

The White Paper on Health introduced a new “Health and Management Information System” (HMIS) comprising several interlinked components: demography, socio-economic status, healthcare status and finance and personnel management. It also introduced a bottom-up approach to service-related data collection and collation in the public sector. The district information system is intended to collect data on various indicators in level 1, 2 and 3 facilities—including indicators of equity, efficiency, effectiveness and responsiveness of healthcare services delivery—so as to provide healthcare institutions with valuable decision-making information (South African National Department of Health, 1981). There is, however, lack of public sector capacity in collating and interpreting information for decision-making, in particular for healthcare capital projects. A culture of using data collected through research for planning, design, construction, monitoring, POE and maintenance is also lacking.

3.9 Health sector financing

The health sector in South Africa is characterised by considerable resource distribution differences between the public and private sectors in relation to the populations that they serve. The private sector accounts for over 60% of healthcare expenditure, but serves a minority of the population. There are a number of concerns about the financing of the private sector, particularly in relation to medical schemes, which account for the largest share of private-sector spending. Medical scheme contributions are increasing faster than inflation and becoming increasingly unaffordable for many citizens. At the same time, they limit the healthcare benefits they provide; for example, those who have lost their jobs, the elderly and the chronically ill are removed from the scheme when their benefits run out and moved to public healthcare facilities (Van Rensberg, 2004a).

In contrast, most of the funding for public sector healthcare services comes from general tax revenue, with a very small amount coming from user fees generated from public healthcare facilities. Overall government expenditure has declined since the 1994 election, as a substantial amount of the tax revenue is being used for servicing debt repayments, limiting the resources available for social spending (Filmer and Pritchett, 1999; Van Rensberg, 2004a).

The national budget for the healthcare sector has grown from USD 1.5 billion in 1994/5 to almost USD 2.1 billion in 2009/10, as shown in Figure 3.3. This constitutes 3 05% of GDP and 11.08% of total government expenditure. Currently, the state contributes 40% of the overall healthcare system expenditure, delivering healthcare services to 80% of the population. Most of the resources are still, however, concentrated in the private sector, which delivers healthcare services to the remaining 20% of the population (Filmer and Pritchett, 1999; Van Rensberg, 2004a).

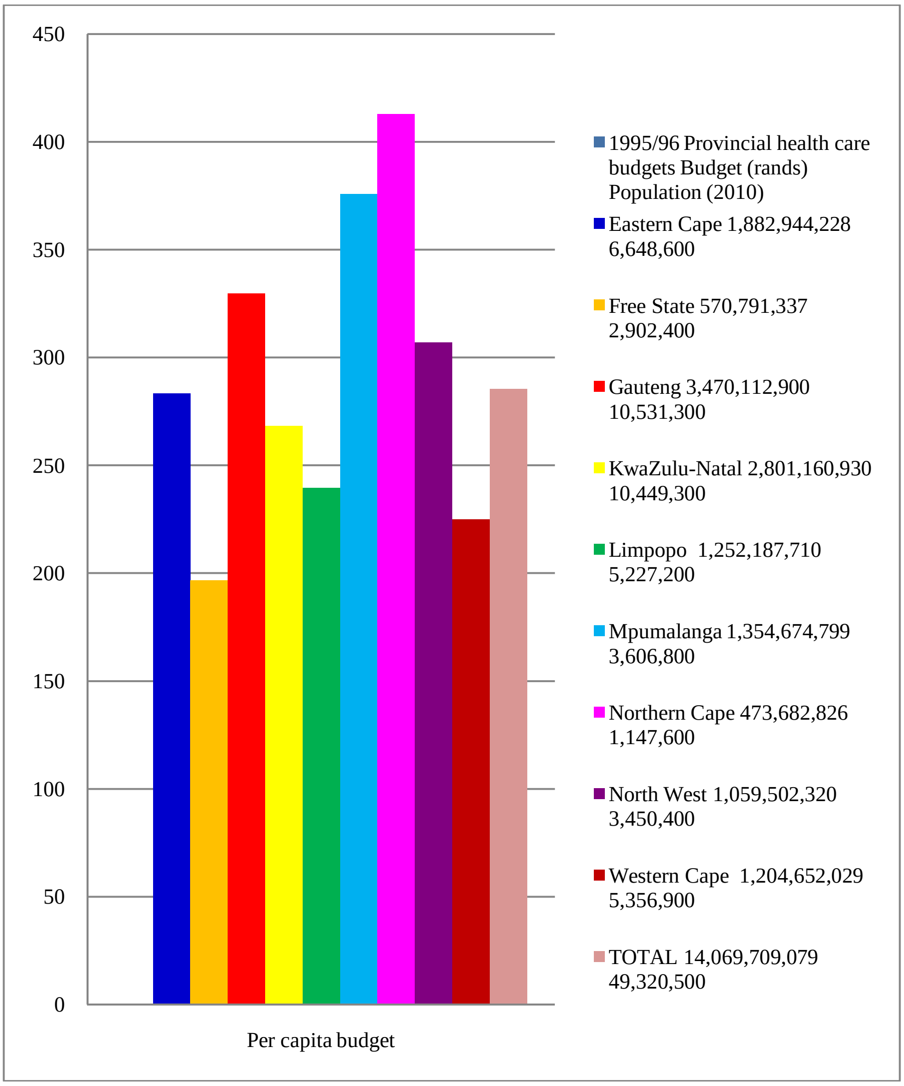

Figure 3.3: Healthcare budget and provincial population 2010

Source: Statistics South Africa 2009

Government interventions at national level aimed at improving access to healthcare services have yielded positive results in all provinces (Glied and Lieras-Muney, 2003). Indeed, South Africa spends a considerable amount of money on healthcare services compared to other middle-income countries. However, the average healthcare status of the citizens is relatively poor when compared to other developing countries. This is because a high level of spending on healthcare services will not by itself result in quality healthcare services delivery. This poor relationship between healthcare expenditure and healthcare status can be explained by the fact that health status is influenced by two sets of factors. The first are income, education, access to healthcare and educational facilities; and the second are the effective and efficient use of healthcare resources. With regard to the latter, it is important that the DGs help control the current excessive timeframe for developing healthcare facilities, the quality of the facilities and the high cost for their development (Bloom et al., 2004).

The redistribution of financial resources needs to be accompanied by proactive efforts to develop adequate management capacity, and a review of implementation tools, such as DGs for healthcare facility projects (Akinboade et al., 2009; Filmer et al., 1997; WHO, 2000; World Health Organisation, 2000b).

C ACCIDENT AND EMERGENCY (A&E) FACILITIES

To create a comprehensive healthcare system with a primary healthcare focus, the government is shifting resources and creating priority areas to reflect community health needs. Tertiary care hospitals in formerly affluent areas are being downsized, while remedial measures are being taken to enhance resources in disadvantaged areas, townships and rural areas. Thus, resources that were previously concentrated in urban hospital systems are being transferred to hospitals in disadvantaged areas. In this context, emergency care has been identified as a priority; and while not considered primary care, it is seen as integral to a comprehensive health care system. This is principally because adequate emergency services have been lacking in many disadvantaged areas (Clarke, 1998).

3.10 Accident and emergency (A&E) facilities: an overview

The A&E facility is known by different names, including: emergency department (ED); emergency room (ER); emergency ward (EW) and casualty ward (CW). The A&E facility provides initial treatment to patients requiring immediate treatment for life-threatening, traumatic and other acute health conditions (Sakr and Wardrope, 2000; Stevens et al., 2006). A&E facilities are heavily used by both low-and middle-income patients, both with and without insurance. These patients seek something they cannot find elsewhere—the right to be seen by a caregiver at any time of the day or night (Koziol-Mclain et al., 2000).

3.10.1 The origin of the casualty ward and DGs used for its development

Several studies show that the use of the CW as a PHC facility for treating casualty patients was first developed during the medieval period by the Romans (Lowden, 1956; Sakr and Wardrope, 2000; Stevens et al., 2006). However, in 1869, the outpatients department at St. Bartholomew's, London was divided into two categories: the CW and the outpatient department. The former was for patients requiring urgent medical attention, while the latter was used mainly for patients needing periodic medical treatment (Sakr and Wardrope, 2000).

The general design requirements in the DGs for this facility were very basic and included the following areas: main entrance, waiting and treatment spaces, and staff support spaces (Sakr and Wardrope, 2000). However, the industrial revolution and the start of widespread use of cars saw a great increase in overcrowding of the CW owing to dramatic increases in accident and trauma cases. This in turn led to an increase in HAI, and consequent need to update the DGs (Fahey, 1964; Horgan, 1962; Stevens et al., 2006).

3.10.2 The need for specialised care and the origin of DGAEF

As interest in trauma care increased and the need for specialist services for fracture patients started to grow, the British Orthopaedic Association (1943) recommended that healthcare services delivery in the CW should embrace the treatment of fractures, infections and other automobile related injuries as there was need for patients to be treated by medical practitioners with the required skills trained to deal with trauma cases.

The Nuffield Provincial Report (1960) on CW revealed that the DGs used for space design and provision were inappropriate, resulting in provision of inadequate spaces for daily-shift workload operations. There were also concerns about the quality of healthcare services delivery from these facilities. These concerns, together with the desire to improve the design of healthcare facilities and the quality of services, formed the basis for the terms of reference of the Nuffield report (Sakr and Wardrope, 2000; Stevens et al., 2006).

Platt (1962) produced the famous DGs for project brief and space design provision for the new A&E facility in 1962, which recommended:

– the name “Casualty Ward Service” be changed to “Accident and Emergency Service”;
– every major A&E unit provide adequate space for three consultants surgeons;
– the A&E unit provide separate spaces for all undiagnosed emergencies as well as accident victims (formally using the A&E unit as a PHC facility);
– the A&E unit be designed based on the operational requirements;
– separate space provision be provided for A&E non-urgent cases;
– major A&E cases be referred to healthcare facilities with adequate space provision for trauma A&E unit where all specialities are available;
– a major A&E unit not serve a population less 150,000.

The Platt report (1962) further recommended that local primary care/A&E and minor injury units fulfil most emergency needs of a population of 50-100,000, while continuing to provide PHC services, social work and other community services to ensure that emergency health and social needs are adequately met, in particular for the low income workers and the uninsured. These PHC if properly designed, equipped and managed could deal with 30-40% of the daily patient workload, before needing to send patients to major A&E facilities.

3.10.3 The crisis of non-urgent cases and the need for DGAEF update

The need to improve equity, efficiency, effectiveness and responsiveness in the new healthcare system policy in South Africa has not yet provided the desired result, with overcrowding of L3 A&E facilities in the past decade on the rise (Andrews and Pillay, 2005). The percentage of A&E visits classified as non-urgent or non-emergency between 2002 to 2004 was substantial, and is higher still today. Healthcare facilities in Gauteng Province alone reported rates of non-emergency visits ranging from 35-45% to as high as 65% of the total daily-shift workload (Gauteng Provincial Department of Health, 2006). This led to the classification of A&E cases according to priority, with Priority 1 (P1) defined as trauma cases; Priority 2 (P2) medical emergencies; Priority 3 (P3) non-urgent emergencies and Priority 4 (P4) patients already dead on arrival at the facility (Department of Health, 1997).

This approach was introduced to limit admission to the very expensive L2 and L3 facilities, and to assist caregivers in directing patients to the appropriate L1 healthcare facilities (Department of Health, 1997). This approach would have succeeded had resources for PHC healthcare facility development and operations and human capital been effectively managed. Indeed, data from Gauteng Provincial Department of Health (2006) shows that significant numbers of new clinics have been constructed, particularly in Gauteng. However, the government has not responded adequately to PHC facilities backlogs in the provinces of Eastern Cape, Mpumalanga, Limpopo, North West, Kwazulu-Natal and Northern Cape.

When these facilities are available, the task is to ensure that they have access to basic services that are critical to improved services delivery, such as water, electricity, communication and information systems (Akinboade et al., 2009; Filmer and Pritchett, 1999; Parsons, 2009). There are frequent reports of poor management affecting efficient and effective services delivery owing to corruption; ethnic and racial problems; lack of trained human resources capacity in healthcare facilities management; geographical location, political, social and economic issues, as discussed in section A (see 3.3, 3.4, 3.5 and 3.6).

The inadequacy of government policy in responding to the healthcare facilities backlog, and in particular in developing an efficient and effective implementation and management strategy for PHC facilities, has resulted in the recent growth in patient populations at tertiary facilities (Schneider et al., 2007). Current A&E facility patient volumes are also attributed to the contextual circumstances discussed in section A (see 3.3, 3.4, 3.5 and 3.6). The high crime rate, sexual violence, HIV/AIDS, high unemployment and poverty are also stretching existing facilities. For example, in 2007, at Chris Hani Baragwanath Hospital (CHBH) A&E facility in Soweto, Johannesburg, on average 400 L1, L2 and L3 patients where attended to in a daily-shift workload (Chris Hani Baragwanath Hospital, 2006). But if, as recommended by Platt (1962), 30-40% of this patient population had access to a L1 A&E facility, the daily average number of patients visiting the CHBH L3 A&E facility would reduce to 230 or 280 (depending on the reduction ratio applied).

Investment in A&E facilities is an essential priority, especially because of the unfortunate legacy of apartheid in providing social infrastructure in non-white communities (Bloom and Canning, 2003). Although the new government healthcare system policy focuses on the development of PHC facilities, the implementation structure and resources allocation is still skewed in favour of the provision of L2 and L3 facilities (Andrews and Pillay, 2005; Schneider et al., 2007).

After a decade and half of post-apartheid government, the newly formed provincial administrations in South Africa still has the statutory obligation for the development of L2 and L3 facilities while local government is responsible for the development and management of L1 A&E facilities. There are currently no holistic integrated development strategies, in some cases because of political and administrative issues (Andrews and Pillay, 2005;

Schneider et al., 2007). For example, funding may be denied to certain local governments owing to the political party in charge of the locality, thereby constraining their capacity to implement healthcare system policy for political expediency. On the other hand, few local governments have the human resource capacity to undertake the planning, design, construction and maintenance of these important facilities (Glied and Lieras-Muney, 2003; Heunis, 2004). While the DGs used for these facilities could have led to cost reductions in some excessive schemes, in most cases they have inflated the net capital expenditure and led to a less integrated facility incapable of responding appropriately to change over time.

All the issues discussed above increase inefficiencies in development of A&E facilities, resulting in under provision of healthcare facilities that can provide short-term relief to the disadvantage population. Hence the importance of understanding the implications of the DGAEF for the A&E facility project development processes.

3.11 The structure of the DGAEF

The slowing down of the South African economy due to the oil crisis in the early 1970s and unpredictable increases in healthcare facilities project costs are among the factors that led to the introduction of DGAEF (Abbott and Cowan, 1989). As introduced in Chapter One, the Webb Committee of Inquiry, appointed in 1975 to investigate ways of limiting overall area cost, was seen as one way to enable more accurate forecasting of the final costs of healthcare buildings (South African National Department of Health, 1987).

The terms of reference of the committee were to make recommendations with regard to the following issues: an overall minimum area per planning unit for L1, L2 and L3 A&E healthcare facilities; cost standards (per unit area) for each planning unit;[18] general principles for determining the number of beds; general and specific requirements for engineering

[18] Planning unit is a measure used to determine the need of the general and specific healthcare service requirement in order to estimate the minimum space area and cost limits to perform the required caregivers operations efficiently and effectively (South African National Department of Health, 1987).

services; and cost standards for furniture and equipments as they are necessary for commissioning the healthcare facility (South African National Department of Health, 1987).

The then National Party government deemed this approach necessary because there were many different DGs in existence for the same type of government buildings (Abbott and Cowan, 1989). The need for and objectives of the DGAEF, are summarised by Cowan and Louw (1986) as follows:

– to determine planning units for each department that accurately reflect the functions performed;
– to formulate area and cost norms for those planning units that do not represent the minimum, but which are nevertheless conservative;
– to allocate space and money for each planning unit that is sufficient to allow staff to carry out their function effectively;
– to provide a system whereby minimal restrictions are placed upon the designer;
– to provide design guidelines that are easy to understand and apply;
– to provide sufficient space and funds to achieve buildings based on the most cost effective engineering solutions and that require the minimum maintenance.

The Webb Report produced the DGs for Health Services Facilities in June 1981 (South African National Department of Health, 1987). This document is still as a benchmarking tool for building norms and cost limits for public sector healthcare facilities.

3.11.1 A critical overview of the implications of the DGAEF in use in South Africa

A&E facility operational processes: The DGAEF should address the following issues faced in most A&E facilities in South Africa: long waiting times; need for improved patient and caregivers privacy and dignity; need for improved caregivers and patient safety owing to high level of HAI; need for increased spaces in the examination/treatment cubicles to accommodate family/visitors; need for increased caregivers' spaces in the examination/treatment cubicles; need for installation of technology for telemedicine and IT developments; need for floor plan configurations that will improve the level of security for the patients and caregivers; and finally, the need for improved facilities for babies, children and adolescents (South African National Department of Health, 1987).

As in other countries worldwide, in South Africa there are typically two entrances to an A&E facility: one for walking patients and the other for ambulance patients, as shown in Figure 3.4 and Figure 3.5. Upon arrival at the A&E facility, the entrance/reception area is the focus of initial presentation, registration, assessment or triage. If appropriate, examination and minor treatment may take place in the assessment or triage area (Hayward, 2006b). Most studies in the literature support the view that non-urgent cases may eventually be discharged from the triage area (Australian Department of Human Services, 2004; Hayward, 2006b; NHS Estates, 2005). In this regard, adequate guidance on patients' movement patterns and caregivers' operational processes is of critical importance, but is not provided in the DGAEF.

Waiting areas should provide sufficient spaces for patients as well as family members/visitors, as shown in Figure 3.4. As there are surveillance and security concerns in this area, the spaces provided for walking, assisted and wheelchairs patients should be observable from the reception and triage areas. Adequate children's areas with sufficient play spaces should be provided within waiting areas. All ancillary and support spaces are located away from where they are needed and are currently not easily accessible from caregivers areas (South African National Department of Health, 1987).

The examination/treatment spaces are not immediately adjacent to the interview spaces. They should contain adequate furniture, equipment and engineering services for examination or treatment of patients. Non acute treatment areas are used for the management of patients with acute illnesses. There are no consultation spaces required for examination and treatment of non-urgent patients (South African National Department of Health, 1987).

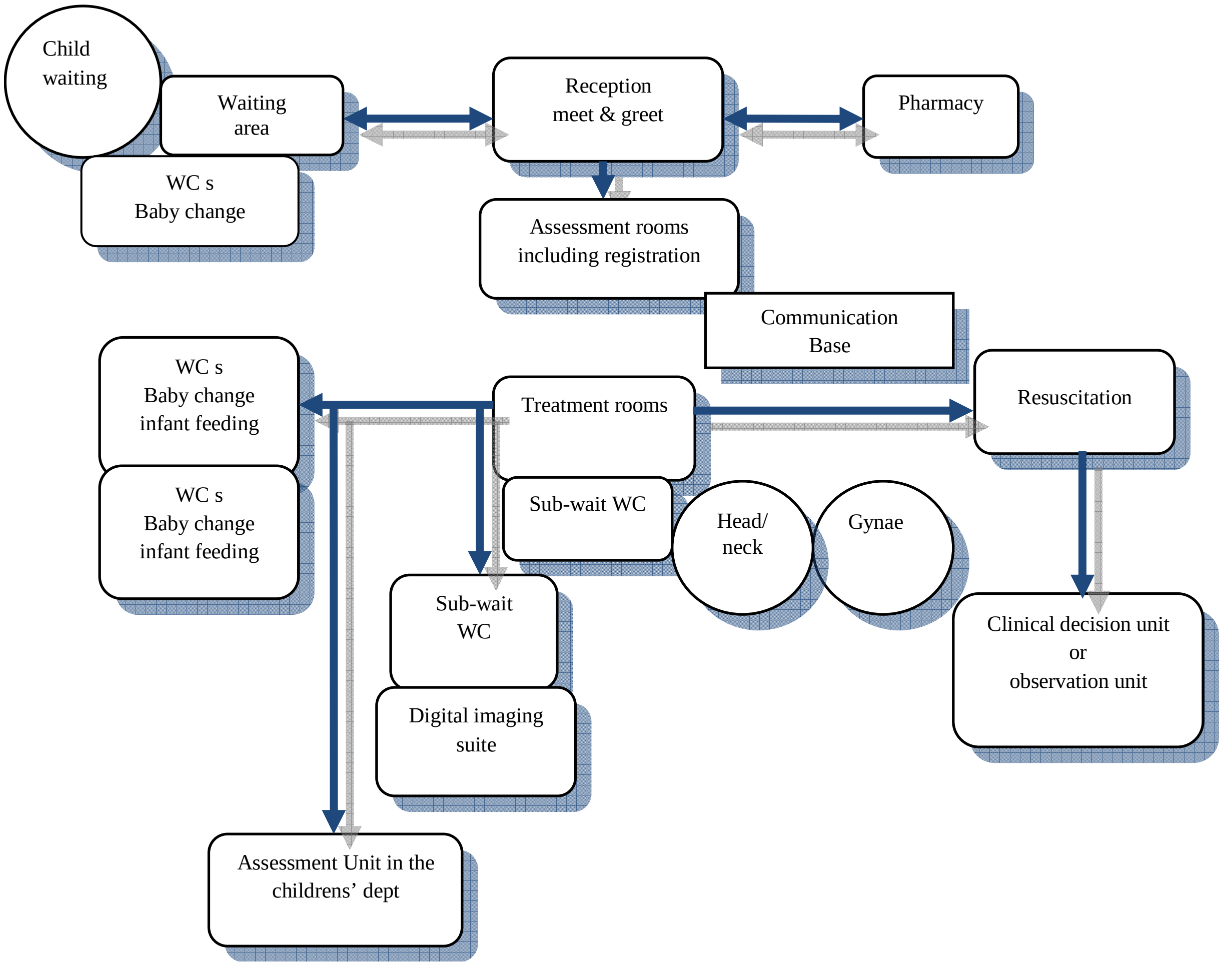

Figure 3.4: A&E facilities spatial relationships at the entrance based on the DGs

Source: adapted from Australian Department of Human Services (2004) and NHS Estates (2005)

There are no general or specific design requirements for decontamination areas, which are necessary for patients who are contaminated with toxic substance, in the DGAEF. There is also no design information for isolation room, which, according to NHS (2005), should be provided as an accommodation space for these patients. This space should be directly accessible from the ambulance bay with appropriate engineering services.

There is inadequate design information in the DGAEF for spaces used for the resuscitation and treatment of critically ill or trauma patients. According to the literature, they should have specialised medical furniture, equipment and engineering services, and adequate circulation spaces for easy movement of caregivers around the work areas. Resuscitation spaces should be adjacent to the radiology department, or should have overhead mobile radiology equipment and resuscitation trolleys with mobile radiology equipment (Australian Department of Human Services, 2004; Hayward, 2006b; NHS Estates, 2005).

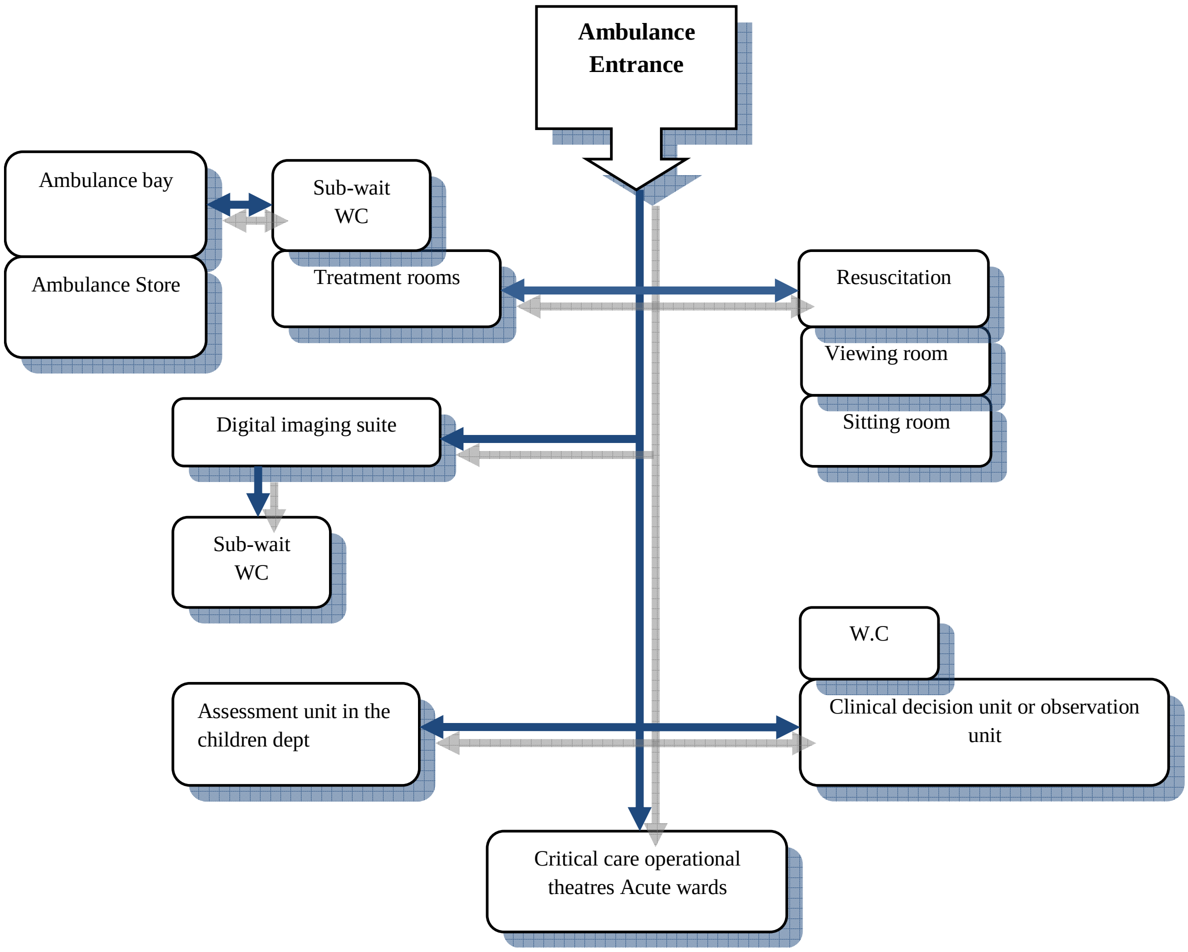

Figure 3.5: A&E facilities spatial relationships for resuscitation area based on the DGs

Source: adapted from Australian Department of Human Services (2004) and NHS Estates (2005).

General and specific design requirements for caregivers' workstations are not included in the DGAEF. Generally, these spaces should be centrally located and provide uninterrupted vision of the patient spaces, and enclosed with raised glass partitions to provide security, privacy and dignity. All support and ancillary areas should be easily accessible to the caregivers (Australian Department of Human Services, 2004; NHS Estates, 2005).

The information systems for the space design and provision of laboratories and pharmacies in the DGAEF are inadequate. The literature recommends that spaces used for laboratory investigations and medication should have adequate storage within the A&E areas, and should be accessible from all clinical areas. Pharmacies should have sufficient space to house a refrigerator, which is essential for the storage of sensitive pharmaceutical products (Australian Department of Human Services, 2004; NHS Estates, 2005).

In brief, there are inadequate information systems in the DGAEF to ensure that all the above issues are adequately addressed in the design tools used for space design and provision for A&E healthcare facilities. Approaches for developing and introducing benchmarking tools in the DGAEF for improving operational process are empirically examined and explained in detail in the following chapters.

3.11.2 The effect of the DGAEF on space design and provision

The DGAEF give the following formula for estimating the number of examination/treatment rooms required in the space design and provision of A&E facilities (South African National Department of Health, 1987):

- planning unit expressed in patient population on every 3 hour peak shift workload;
- need norm estimated based on number of emergency patients in a 3 hour peak shift workload, using the outpatient norm where the number of patients is less than 60 during a 3 hour peak shift workload;
- area norm per square metre estimated on providing 430 m^2 for the first 60 patients, allowing additional 100 m^2 for every additional 50 patients.

The information system provided in the DGAEF overlooked the introduction of flexible formulas, which is asked for in the terms of reference for healthcare facilities projects. For example, the mandatory 430 m^2 for the first 60 patients during a 3-hour peak shift workload and allowing for an additional 100 m^2 for every extra 50 patients is argued to be just as good as using universal formula. Thus the DGAEF provide no detailed information for determining the following variables: expected patient volume distribution factors, such as patients admitted in the healthcare inpatient facility that are no longer A&E patients upon arrival; acute/resuscitation patients treated in different A&E areas; and fast track patient numbers immediately subtracted from the actual A&E patient population (Okpanum, 2003).

Weitzner (2006) and Gow (2007) similarly indicate that the shift distribution should be categorised as follows: day, evening and night, allocating each category with a variable increasing or reduction factor based on historical data or realistic expectations of daily projected patient visits. There are concerns about the omission of these variables in the formula used for calculating space programming in the DGAEF. Based on the evidence, the above formulas have led to inefficient and ineffective space design and provision, functional suitability and spatial relationships (see Section 3.12.3). There are also concerns about the omission of the following key variables for the calculation of the number of examination/treatment spaces: estimated peak number of daily visits, and examination and treatment turnaround times. In addition, adopting universal formula for estimation of the number of examination/treatment spaces in the DGAEF is considered inappropriate.

The above argument is supported by Hamilton (2009), who asserts that DGs for healthcare facility design need not set minimum or maximum areas, as requirements for every institution may vary due to contextual and operational conditions. There is also inherent danger in using universal DGAEF owing to regional differences in epidemiology, services demand and availability of resources, which may be difficult to include in DGAEF formulas. For example a small community A&E healthcare facility may not require the same accommodation or space provision as an urban A&E healthcare facility owing to contextual factors and resource constraints.

The implications of the omission of some of the key variables for estimating the number of examination/treatment spaces in the DGAEF is investigated empirically and discussed in detail in this study in the following chapters.

3.11.3 The effect of DGAEF on functional suitability and space utilisation

There is a growing body of evidence associating poor information systems in the DGAEF and incomplete project brief to negative outcomes in terms of inadequate project communication and management protocols; frequent modifications to the design, even during construction; long construction timeframes; poor space usability and functionality; and unpredictable project costs (Weitzner, 2006). The findings of the POE studies carried out by the researcher on various completed projects designed and built using the DGAEF, to verify whether key objectives had been met, are consistent with these findings. Few showed positive outcomes in relation to Planetree principles for project development and operations of the healthcare facilities (Okpanum, 2002; 2004).

Hignett and Lu (2008a) and Francis et al. (2001) assert that to ensure that space design and provision meets the needs of patients/caregivers/family members/visitors, the DG update should develop detailed information systems and benchmarking tools for improving:

– the communication tools used for the overall development of the healthcare facilities projects;
– the effectiveness and efficiency of design tools for space design and provision;
– participatory approach protocols for project implementation process;
– technology innovation and update;
– institutional transformation and organisational change; and
– standardisation of the project development processes and life-cycle costing.

Functional suitability and space utilisation are affected by physical attributes such as overall space provision, spatial arrangement and the floor plan configuration. All these physical attributes affect caregivers' capacity efficiency with respect to: hunting-and-gathering tasks for supplies; multiple use spaces; visual privacy from the corridor; access to supplies and transport in/out of room. Therefore, the impact of the DGAEF on functional suitability and space utilisation is examined and discussed in following chapters.

3.11.4 The effect of the DGAEF on spatial relationships and experience

Spatial relationships in the workplace, according to Wilkins and Ouchi (1983), can influence organisational performance if the physical environment is designed with knowledge of the current organisational culture. The physical setting of an organisation is a tangible artefact, symbolising the organisation's attitude towards its caregivers, patients and the community (Schein, 2004). The DGAEF should provide information that can positively influence the design philosophy and concepts which are essential for encouraging good space design and spatial relationships of A&E facilities (Hamilton, 2008).

The arrangement of spatial relationships in relation to integration of spaces provided with design features for directional cues, spaces for supplies and engineering services can reduce the time spent by caregivers in intangible work; for example, as pertains to access to supplies and, in particular, for giving directions to patients and visitors (Hendrich, 2003b).

The A&E facility floor plan configuration requires spatial relationships with these key functional areas in this order: radiology unit; operating department; coronary care unit; pathology/blood bank unit; inpatient accommodation unit; pharmacy; outpatients; medical records and mortuary (Australian Department of Human Services, 2004; NHS Estates, 2005). It is important that space relationships are grouped in this order to facilitate the caregiver's workflow processes (Gow, 2007; Lehtonen et al., 2003; Miller, 2007; Nestor, 2009; Nestor and Eriksson, 2009).

The above issues show that the healthcare institution, caregivers and the design team need to work together as an interdisciplinary team to define a space adjacency matrix that can improve capacity efficiency of the A&E facility (see 2.3). The role of DGAEF in providing the requirements for the creation of interdisciplinary team during all phases of healthcare facility projects, from inception to completion and during operation, is explored empirically and discussed in the following chapters.

3.12 Current trends in DGs for A&E facility spaces

The DGAEF recommends that A&E facilities are divided into three functional zones: clinical; nursing and support. There is however little information in the DGAEF on accommodation schedules, space types, quantities of each space type; and required space areas with minimum dimensions for each zone. The functional relationship diagrams specify the ideal adjacency matrix for efficiency of the A&E operational processes, but provide little information on evaluation systems for space use, space character, form, materials, performance, patient safety (reduction of HAI) and patient/caregiver/visitor interaction (South African National Department of Health, 1987).

Moreover, the literature demonstrates that healthcare systems around the world have a number of universal characteristics that point to improvement recommendations for rating systems; unpredictability of patient flow; patient classifications; prioritisations; queuing systems; implementation of electronic systems and some of the specific process improvements. In most countries, these improvement recommendations are used without taking into consideration contextual issues (Lehtonen et al., 2003).

DGAEF informed by the operational philosophy of the healthcare institution should naturally support the intended purpose of the design. Indeed, according to Hamilton (2004), design hypotheses based on the correct interpretation of the operational systems can provide credible evidence to support the aim of the project and measurable improvement outcomes in efficient and effective use of resources. In addition, using DGAEF developed through research for space design and provision can result in measurable performance improvements on the outcomes of healthcare services delivery.

3.12.1 The influence of new trends in healthcare facilities on operations and DGAEF

Findings from a study on A&E operational improvement through DGAEF in the United States show that design is a key factor affecting operational efficiency and flexibility (Gulwadi et al., 2009). In South Africa, the DGAEF are not based on Planetree principles, and, in the informed opinion of the researcher, the majority of A&E facilities have floor plan configurations that do not comply with the objectives of the DGAEF (see 3.17.2). Moreover, those that do comply, when evaluated based on the new paradigm for patient/caregivers/family centred design principles, do not have spaces that can be easily standardised with minimal renovation works and may not be fit for current operational processes (Okpanum, 2001; 2002; 2003; 2004).

Gulwadi and others (2009) are of the view that the incorporation of the new paradigm for healthcare facilities based on Planetree principles in the DGAEF is necessary to respond to the new operational processes and technological innovation. Indeed, recent trends in the delivery of quality healthcare services have seen progression from treating episodic illness to a more cost effective and efficient longitudinal care orientation in a A&E facilities, which are now serving increasing number of underserved population.

A&E facility floor plan configurations reflect the information contained in the DGAEF and are also frequently based on the opinion of a single caregiver who often has left the healthcare institution before the facility is completed and commissioned (Weitzner, 2006). The design process also sometimes comes to a halt due to continual reviews of the layout in the absence of leader who can take decisions before the design team can proceed with the next project development phase. Several studies assert that challenges related to poor quality of the finished product, unpredictable timeframes and cost overruns have led to the introduction of a "design and operational system-based perspective" as the new approach that can provide positive measurable outcomes during project briefing, design, construction, operations and maintenance (Gow, 2007; Hayward, 2006b; Pallin and Kittel, 1992; Rotondi et al., 1997).

"Design and operational systems-based perspective": The introduction of "design and operational system-based perspective" has led to the creation of an integrated interdisciplinary team comprising subproject teams for design, construction and operational systems that are part of the new paradigm underpinning the project development strategy for healthcare facilities projects in US and UK. This model addresses issues of identity, obligation and influence in the DGAEF, which affect design culture as discussed in Chapter Two. The "design and operational system-based perspective" is a coordinated delivery project strategy, involving a structured participatory process during project implementation, that helps ensure

desired outcomes in space design and provision, functional suitability and spatial relationships are achieved (The Center for Health Design, 2009).

The need for renovation or new works provides an opportunity for institutional transformation. The design of the facility can be used to entrench the vision and objectives of the healthcare institution. The new design paradigm focuses on integration of people, processes, technology and the physical environment. Thus, the transformed institutional culture implemented through design is translated and communicated to the caregivers/patients/visitors through continuous feedback during project implementation and after commissioning (Cherns, 1976; The Center for Health Design, 2009).

The interdisciplinary project team must be committed to using the “design and operational system-based perspective” approach if it is to create a physical environment that can lead to measurable performance improvement in capacity efficiency through change in workflow process and quality healthcare services delivery (Cherns, 1976; The Center for Health Design, 2009).

From the above analysis, this may require the interdisciplinary project teams to standardise workflow processes, and communicate all process changes in space provision innovation, technology systems and infrastructure needed to support the initiative and create consistency across the facility. Thus, the role of the DGAEF in the new trend in healthcare facilities project development is explored empirically in following chapters in this study.

3.12.2 The implications of DGAEF on space design and provision

The DGAEF in South Africa are a key factor affecting operational processes and capacity efficiency. An example is the consequences of the lack of general and specific design requirements in the DGAEF for triage spaces, children’s spaces, registration spaces, laboratory spaces, staff areas, storage spaces, waiting areas, patient safety, and overflow capacity during peak workload and disasters. This analysis is supported by studies in the literature on the influence of the physical environment on caregivers work experiences and the measurable positive outcomes in throughput (Gow, 2007; Lehtonen et al., 2003).

Minor renovation works to increase space provision for improvement of operational processes in most of the existing A&E facilities in Johannesburg, South Africa have resulted in positive measurable outcomes in healthcare services delivery (Heunis, 2004). This is supported by the findings from the study by Hamilton (2009), suggesting that there is direct interrelationship between operational processes and the physical room attributes, such as overall space provision and caregivers' efficiency. Another key factor that influences caregivers' efficiency is the ability to move around examination/treatment cubicles without obstruction. Obstacles in the caregivers' zones and lack of adequate space or access to patients reduces the efficiency of care processes (Debajyoti et al., 2009c).

The issues emerging from the above analysis on operational improvement through space design and provision using the DGAEF identifies the following factors that can result in measurable performance improvement:

– triage located directly at the entrance with expanded spaces for initial care and probably discharge or admission to the inpatient unit;
– registration space away from triage space;
– designing multiple use rooms/universal spaces for functional flexibility and adaptability;
– space design to enhance patient/visitor visibility;
– interior design and treatment to enhance ambience;
– installation of electronic tracking devices;
– electronic medical records;
– automated discharge instructions and prescriptions;
– installation of communication/IT devices to enhance communication between caregivers and standardised the whole process.

In brief, the role of DGAEF on the new trend for space design and provision is empirically investigated and explained in the following chapters.

3.12.3 DGAEF update and standardisation, flexibility and adaptability

Most of the issues affecting equity, efficiency, effectiveness and responsiveness in delivery of healthcare services in South Africa are due to the limited capacity of the public sector and inefficiencies in resources utilisation, as discussed in Sections A:3.6.2 and B:3.10. The findings from numerous studies support the argument that the design tools in DGAEF lack adequate evaluation mechanisms for space design and provision; functional suitability and space utilisation; spatial relationships and experience; continuous feedback process; standardisation; flexibility and adaptability for project implementation and operational processes (see 2.8). Indeed, the use of the open cubicle floor plan arrangement, as recommended in the DGAEF, and categorisation of the functional spaces into three zones—clinical; nursing and support areas—may no longer be appropriate to today's A&E facilities' context (see 3.12.3).

POE of four primary healthcare care (PHC) facilities undertaken in Johannesburg by the researcher, found that, two years after commissioning, half of the total area, excluding toilets, cannot be used for purposes other than originally intended (Okpanum, 2003). The findings from these POE studies suggest that DGAEF may not respond to the need for flexible and adaptable floor plan configurations if they are too prescriptive.

From the above discussions it is clear that the DGAEF provide limited general and specific design requirements on standardisation, flexibility and adaptability that are essential for designing spaces for multi-use based on inevitable future operational changes. Thus the role of the DGAEF in influencing standardisation, flexibility and adaptability of the overall project development and operational processes is examined empirically and discussed in the following chapters.

3.13 Gaps and limitations in the DGAEF

The issues discussed in this section reveals that there is consensus amongst researchers on the gaps and limitation in the DGAEF constraining the improvement of the design of A&E facilities. For example, according to Hayward (2006a:13):

> "The design guidelines need to be developed as something that people can use easily: there is lack of flexible tools for developing generic document with more information on space design, functional suitability and spatial relationships. To encourage participation by all entrenching these concepts: identity, obligation and influence and introducing design performance indicators for evaluation, communication, translation and feedback".

WHO (2004:8) affirms that:

> "Government should improve the implementation strategies of the healthcare systems objectives: in particular in relation to equity, integration, distribution and attachment. It is vital that A&E facilities should be provided in all communities through the use of efficient and effective [design guidelines] to ensure that the above objectives are achieved. In addition, there is lack of benchmarking tools for improving on technology innovation in the [DGs] to encourage: space design; space relationships; construction and operational process. In order to address these challenges on space design and provision and utilisation: flexibility; adaptability; management; efficient use of resources and procurement issues".

And Hamilton (2009:54) suggests that:

> "The main problems and challenges are in providing research based information in the [DGAEF] explaining its interrelationship with, spaces design, functional suitability, spatial relationships and institutional transformation. There are also lack of research based design tools for standardisation of the project development and operational processes. The introduction of research based information in the DGs is also a challenge for defining ways of improving: standardisation; flexibility; adaptation; quality; time and cost based on performance measures associated with specific design intervention".

In brief, the design of improved A&E facilities faces problems and challenges owing to the gaps in the DGAEF identified above, which constrains operational processes and impacts on equity, efficiency, effectiveness and responsiveness. The gaps identified are categorised into the following themes: design tools; quality of the physical environment; and perception or impact.

3.14 Summary and conclusion

South Africa's apartheid past and subsequent political system has significantly influenced government policies, the healthcare system and healthcare facilities development. The ANC government, when it assumed power in 1994, found a plural healthcare system divided into two parallel sectors—a public sector financed by the government; and a private sector funded through medical aid, largely serving the white minority population. The healthcare system was disorganised, highly inequitable, expensive and inefficient. The government has thus adopted numerous policy initiatives to transform the healthcare system.

To create a comprehensive healthcare system with a primary healthcare focus, the government is shifting resources and creating priority areas to reflect community health needs. Resources that were previously concentrated in urban hospital systems are thus being transferred to hospitals in disadvantaged areas. In this context, A&E facilities have been identified as a priority, as they have been lacking in many disadvantaged areas. However, the need to improve equity, efficiency, effectiveness and responsiveness in the new healthcare system policy in South Africa has not yet provided the desired result, with overcrowding of L3 A&E facilities in the past decade on the rise. Delays in A&E facilities development are adding to the pressure on existing and functioning ones, and constraining efficient and projects effective healthcare services delivery to the community. These delays can be largely attributed to problems in the application of the DGAEF. Hence the importance of understanding the implications of the DGAEF for the A&E facility project development processes.

The issues emerging in the preceding Chapter Two and this chapter have enabled the theoretical foundation of the study to be established, and the research topic to be put in its geographical, historical, political, social and economic context. The research methodology is discussed in detail in the next chapter.

4 CHAPTER FOUR

RESEARCH STRATEGY AND METHODS

4.1 Introduction

This chapter elaborates the research strategy and methods used for this study. It describes the development of the research strategy as well as the sampling techniques, survey procedures, data collection methods, data analysis and limitations of the study.

The chapter consists of five main sections. The first describes the research methodology, while the second and third respectively discuss the research design and empirical research process. The fourth and fifth sections explain the data collection and data analysis procedures. The chapter concludes with information on the limitations of the study, and a summary.

4.2 Research strategy and methodology

The research strategy facilitates the collection, compilation and analysis of data. It provides the preliminary approach for choosing the concepts, theories and definitions of the topic of inquiry. It also provides the basis for critical analysis of events unfolding in life-world situations (Groat, 2002).

The research strategy determines the research methods, of which there are many. The challenge lies in the ability to understand and choose the appropriate method or methods for the topic of inquiry, with respect to the key issues and dimensions that are to be researched, analysed and discussed; the kinds of data they generate; and their relative emphasis on deduction[19] or induction.[20]

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[19] Deduction or nomothetic methodologies focus primarily on systematic protocols and techniques, and emphasise scientifically rigorous testing of hypotheses (Burrell, 1979).

[20] Induction or ideographic methodologies focus on grounded theory techniques, in which the emphasis is on theory grounded in empirical observations, taking account of subjects' meaning and interpretational systems, to gain explanation by understanding (Burrell, 1979; Gill and Johnson, 2002).

Research strategies and methodologies for healthcare facilities project development have evolved in the 20th Century owing to dramatic socio-econo-political, technological and architectural transformation of healthcare buildings, and new trends in health-related quality of life (Wagenaar et al., 2006). In particular, the last decade has seen the emergence of evidence-based design as a new approach to improve the quality and fitness for purpose of healthcare facilities (Sailer et al., 2008). Hence, this research builds on previous research, in turn becoming a foundation for the research of others.

4.3 Approaches to development of research design

The overall aim of this research, as elaborated in Chapter One, is:

"To assess the role of design guidelines for A&E facilities in South Africa so as to make recommendations on how to improve their design and project development process".

The key research questions formulated to address the above aim are the following:

(i) Are DGAEF followed?

(ii) How effective and efficient are healthcare services delivered from A&E facilities?

(iii) What are the contributions of buildings towards effective and efficient A&E operations?

The nature and complexity of the knowledge required to answer the above questions necessitates a holistic approach. The choice and adequacy of the research design and methodological approach are dependent on various assumptions regarding the nature of the knowledge sought (Yin, 2003). As Merriam et al. (2002) affirm, what one finds or learns is a product to the research design and methods employed. Therefore, it is important that a set of questions are developed to assist the researcher select the appropriate research methodology. Table 4.1 shows the key questions posed in developing the methodological framework of this study.

Table 4.1: **The key questions for the development of research design**

The key questions for the development of research design
1. What strategies can be used to explore, understand and gain knowledge for the update of the DGAEF?
2. What are the most appropriate ways of investigating and analysing the key dimensions/sub-dimensions of the DGAEF?
3. What are the sources of data on the DGAEF and to what extent can access to this data be gained?
4. What kind of data, information and evidence need to be collected for DGAEF update?
5. What is the most appropriate way of selecting the context for the DGAEF study and a representative sample?
6. How, where and when can the DGAEF be investigated?

4.3.1 Key stakeholders in the DGAEF update process in South Africa

To explore, understand and gain knowledge on the processes of DGAEF development and use, it was helpful to identify the key stakeholders involved. They include: national departments of health, finance and public works; provincial departments of health and public works; caregivers (physicians and non physicians); consultants (architects, engineers and quantity surveyors); and patients/community. Other stakeholders and institutions may also have direct and indirect influences on the general and specific requirements in the DG and it is necessary to involve them in the process of its update as outlined in Chapter Two. Figure 4.1 shows the key stakeholders in the development and use of DGAEF.

4.3.2 Key research dimensions and sub-dimensions

The key research issues to be addressed must be clearly defined to facilitate empirical investigation and analysis (Gill and Johnson, 2002). Creating rules for making observations produces clear definitions of what it is to be observed; and simplifies abstract concepts to observable and testable issues by using indicators to improve reliability of measurement. This approach also produces key research dimensions and variables related to the study's conceptual framework (Robson, 2002). Clarification of the conceptual framework is not a "once-and-for-all" process which precedes research; rather, it is a continuous process with constant interaction between data analysis and concept clarification (De Vaus, 2002).

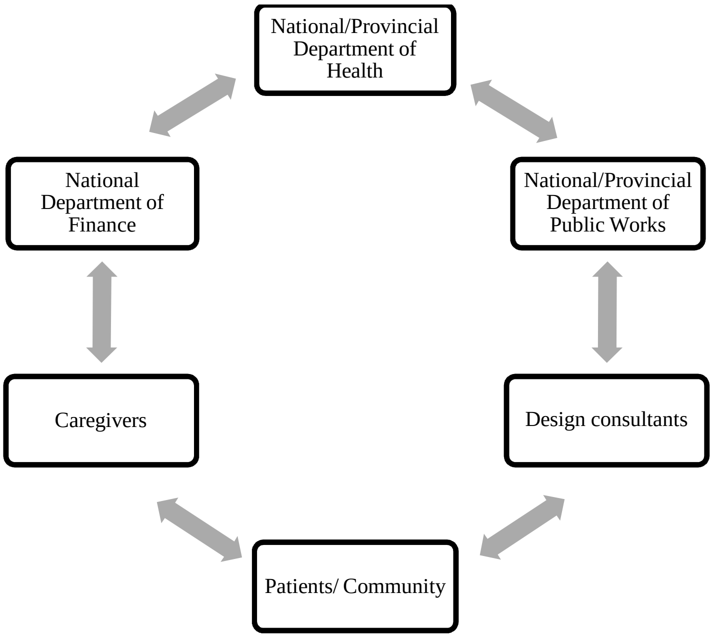


Figure 4.1: Key stakeholders in the DGs update

The present study's conceptual analytical framework is illustrated diagrammatically in Figure 4.2. It comprises two key dimensions identified through the literature review and concept mapping[21], namely (i) the structure of the DGAEF and (ii) the structure of DGAEF based on Planetree principles. These two main dimensions comprise respectively two and four sub-dimensions, with corresponding variables, as listed below.

The two key sub-dimensions of the DGAEF are:

(i) DGAEF as a medium of communication (interpretation, translation, continuous feedback evaluation, and education);

(ii) DGAEF as a tool for effective use of resources (integration, distribution, equity, attachment, and value for money).

The four sub-dimensions of the DGAEF structure based on Planetree principles are:

(i) DGAEF as a medium for participatory process (identity, obligation, influence/ needs/ usability, knowledge and involvement);

[21] Concept mapping is an approach by which brainstorming with other people helps explore the different ways in which a concept might be analysed and simplified (De Vaus, 2002)

(ii) DGAEF as a tool for technology innovation (performance, operational process, continuity, information systems/visualisation, and physical environment);

(iii) DGAEF as a means for institutional transformation (accessibility; management; quality of services delivery; procurement; and experience);

(iv) DGAEF as a tool for standardisation (repetition, pre-assembly, flexibility/ adaptability, and satisfaction−quality, time, cost and aesthetics).

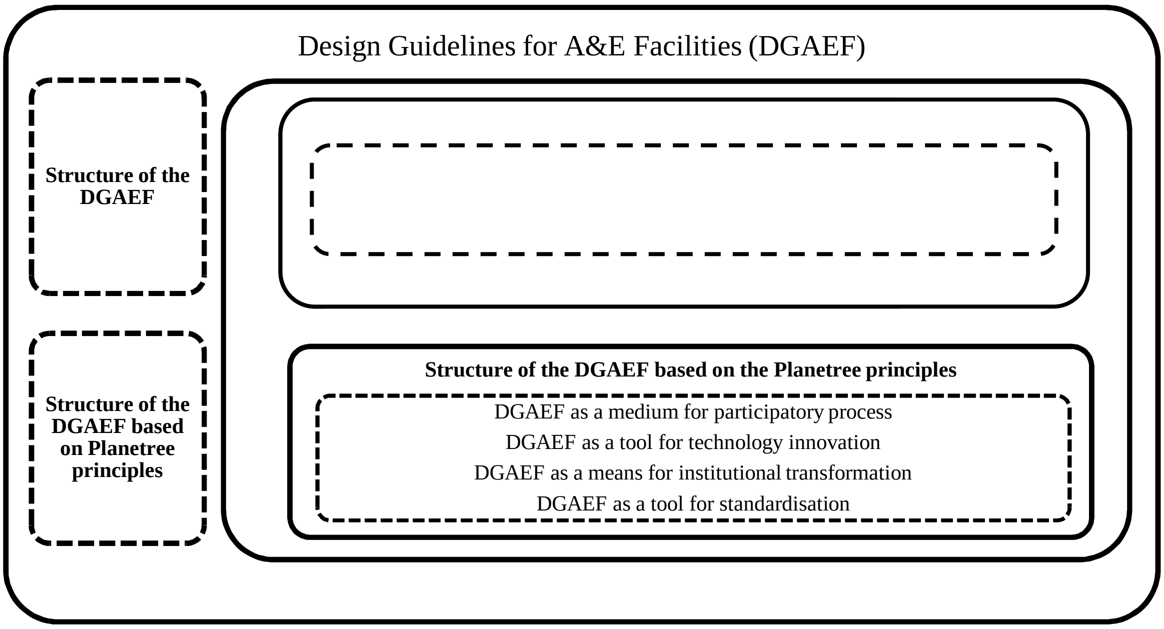


Figure 4.2: Key research dimensions and sub-dimensions

The process of defining and simplifying the conceptual analytical framework for DGAEF update underpinned the development of the research design which guided the analysis and discussions in Chapters Five, Six, Seven and Eight respectively.

A process of descending the ladder of abstraction to deconstruct the broad concepts into clear and key dimensions, sub-dimensions and indicators or variables was followed (De Vaus, 2002). The breaking down of the abstract concepts to a set of testable issues and indicators or variables helps direct emphasis on the main research sub-dimensions, guiding the type of data and information to be gathered. This process, as followed in this research, is illustrated diagrammatically in Figure 4.3.

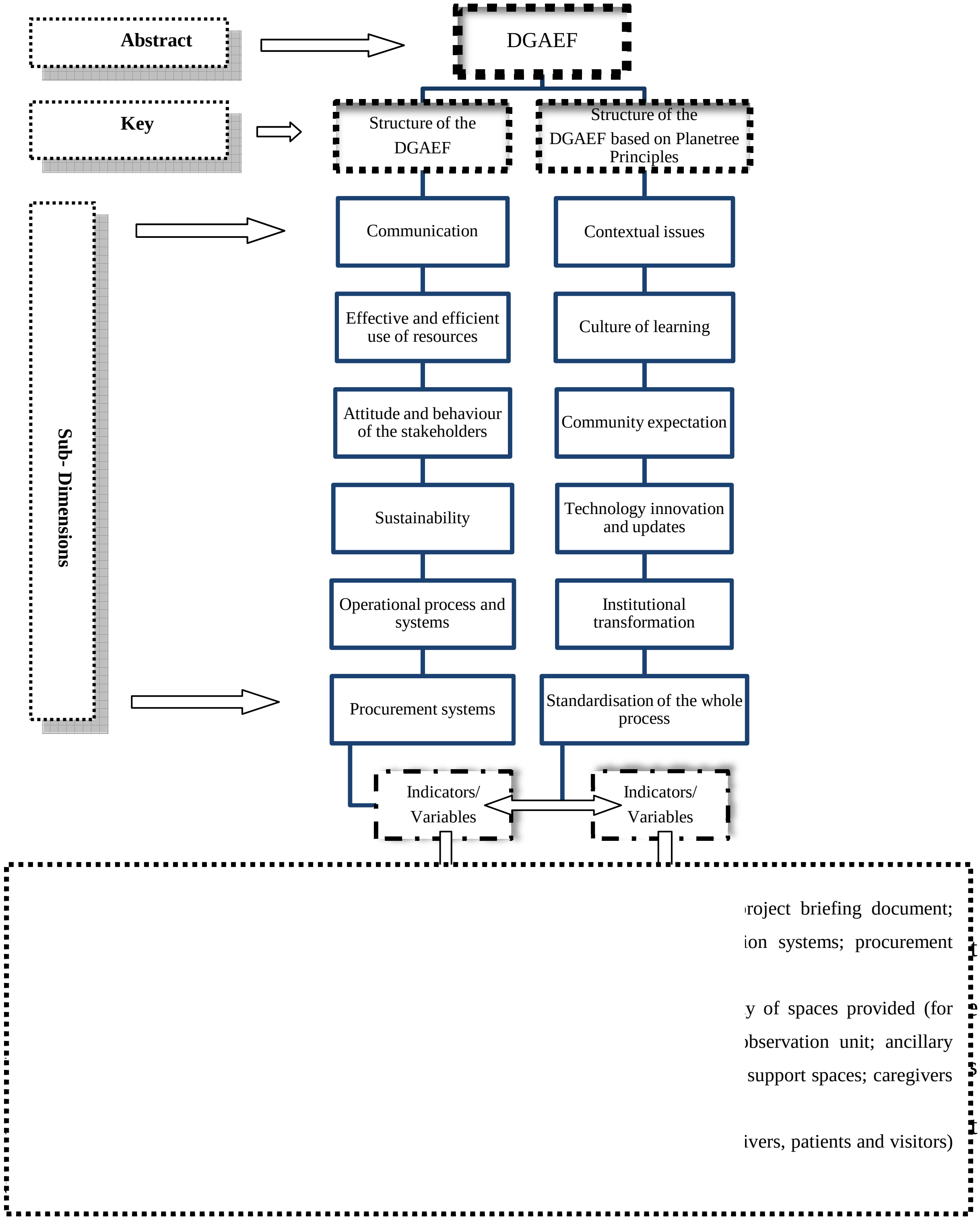


Figure 4.3: "Ladder of abstraction"

4.3.3 Research design

The key components of the research design, as identified by Hakim (1987), are the research aim, theory, research questions, methods and sampling strategy. To achieve the stated research aim, the strategies and methods employed must be appropriate for the research questions to be answered (Yin, 2003). The research design involved two approaches: theoretical and empirical. The theoretical strategy comprised the research aim; conceptual framework; theoretical context; key dimensions and sub-dimensions; and development of the research questions and design. The empirical design included multiple methods—questionnaires; in-depth interviews; floor plan analyses and observational studies.[22] The research design process is summarised diagrammatically in Figure 4.4.

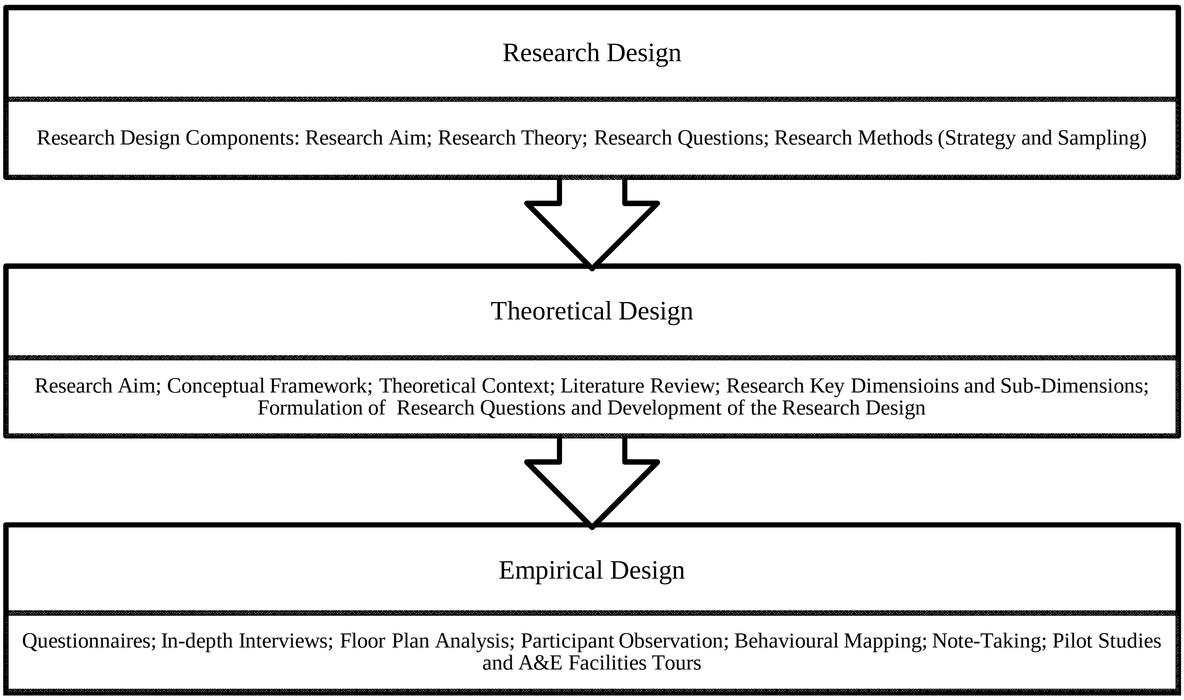


Figure 4.4: Research design process

4.3.4 Theoretical research design

The theoretical strategy is a critical component of any research, as its main focus is to lead to a greater understanding of the subject of study. This initial and continuous component of the research consists primarily of the literature review, with particular reference to the DGAEF in South Africa. The theoretical research design was developed through conceptual framing of issues emerging from the literature review and POE studies conducted by the researcher on healthcare facilities in South Africa (Okpanum, 2002; 2003; 2004).

[22] See Appendices C, D, E, F, G and H.

The theoretical research design is fundamental to comprehensively formulating and developing the research aim; philosophical, conceptual and theoretical framework; and key dimensions and sub-dimensions; as well as the research questions and methodologies. By providing a better understanding of current trends in DGAEF and their use for space design and provision, functional suitability and spatial relationships, the theoretical research process provided a better understanding of the possibilities for the DGAEF update; and thus facilitated the choice of the research context, methodology and the design of empirical research.

4.3.5 The empirical research design

The empirical research design provided the framework to guide the analysis of the key research dimensions and sub-dimensions presented in Figure 4.2. It also guided the conduct of the fieldwork, in addition to other relevant research activities. The empirical research design dictated data collection process and other field-related aspects of the study, including the collection of empirical data relating to DGAEF through multiple methods, including questionnaires; in-depth interviews; floor plans analysis and observational studies.[23] The empirical research and data collection processes are explained further in the following section.

4.4 Empirical research process

The empirical research process for this study was guided by the research design as explained in the preceding section. It was also informed by feedback from the exploratory trips to South Africa and pilot studies, and the practice-based experience of the researcher.

4.4.1 Data collection process

The research design and methodology facilitated collection of sufficient primary and secondary data, in addition to gathering of relevant information on the topic of inquiry before

[23] See Appendices C, D, E, F, G and H.

conducting the main fieldwork. Hence political, socio-economic, cultural and organisational factors within the research context were able to be taken into account (see 3.5, 3.6 and 3.7).

Understanding, interpreting and explaining the impact of DGAEF on A&E development is a complex process owing to the large number of variables involved, which include these design variables (strategic and project briefing document; design solutions; technical/construction documentation; project cost estimate; construction systems; procurement processes and project programme; commissioning process and POE); built environmental variables (accessibility; quality of examination and treatment spaces; noise level; single vs double rooms; safety; wayfinding; positive distractions; patient and family control; family support spaces; staff support spaces; physical support spaces); and perceptions (level of satisfaction and services quality).

The data collection process used a mixed-methods approach, involving qualitative and quantitative data collection methods to enable confirmation or corroboration through triangulation (Sieber, 1973). This approach is essential to a comprehensive and reliable analysis of the phenomena under investigation (Miles and Huberman, 1994). The data collection process is summarised in Table 4.2.

4.4.2 The planning of data collection process

The data collection phase was organised in three fieldwork trips to Johannesburg and Pretoria. The first, in September 2006, was instrumental in determining the most appropriate setting for the research and in the decision-making process for data collection phase. In this phase, the researcher undertook a situation analysis of existing A&E facilities in Johannesburg and Pretoria with the aim of selecting those most appropriate for the study, as shown in Figure 4.5. Information on the required permission from Gauteng Provincial Department of Health to conduct the study, and gaining of access to necessary information was also obtained.

Table 4.2: Data collection process

Data collection activity	Observational studies	Survey/Interviews
What is the topic of the study? (DGAEF)	Key actors in the field and individuals who have experienced the phenomenon were involved	Case studies and survey on DGAEF
What are the procedures for gaining access to information and communication with the participant?	Obtaining permission from research ethics committee from University Johannesburg and seeking informed consent from the key stakeholders who have experienced the phenomena	Gaining permission from Gauteng Provincial Department of Health
How is random or purposeful sampling conducted?	Purposive sampling through random selection of research subjects	Pilot study aided the selection of most representative setting for the study
What type of information is collected?	Observation and measurement of the floor plans of the exiting two A&E facilities and in-depth interviews with the key stakeholders (consultants, department of health/public works staff, caregivers, patients and the community)	Questionnaires, in-depth interviews, floor plan analysis, observational studies, behavioural mapping, literature search, note taking and analysis of grey literature and medical records
How is the information recorded?	Note taking on floor plans sheets, using computer word and excel software programmes and interview protocols	Note taking and computer filing systems were used categorising all information collected in a systemic way in their appropriate folders as well as using traditional filing folders
What are the fieldwork challenges?	Obtaining information on the topic was not easy. It required lots of effort from the researcher to explain the link between DGAEF and quality of the healthcare physical environment	Conducting floor plan analysis in a fully functional A&E facility and interview as well as observational issues
How is the information coded and stored?	Classifying responses, coding according themes, transcriptions and computer files	Fieldwork notes, identifying categories of responses, coding according to themes, translation, documenting and storing using appropriate filing systems

Source: Adapted from Creswell (1998)

The second trip in June 2007 was a pilot study, during which preliminary informal interviews were conducted with consultants (architects and quantity surveyors), Gauteng Provincial Department of Health and Public Works staff, and caregivers (doctors and nurses). The unstructured interview format was based on the initial information and data gathered, and analysis of the first exploratory field study. The analysis of the data collected during this trip aided the selection of the four pilot case study A&E facilities. These initial exploratory studies, informed the selection of the final two case studies used for the empirical research.

The main fieldwork was undertaken from November 2007 to February 2008, and involved three fieldwork trips as shown in Figure 4.5. The overall purpose of this phase was to carry out case studies of the A&E facilities at CHBH and PAH using questionnaire and interview surveys; floor plan analyses and observational studies.

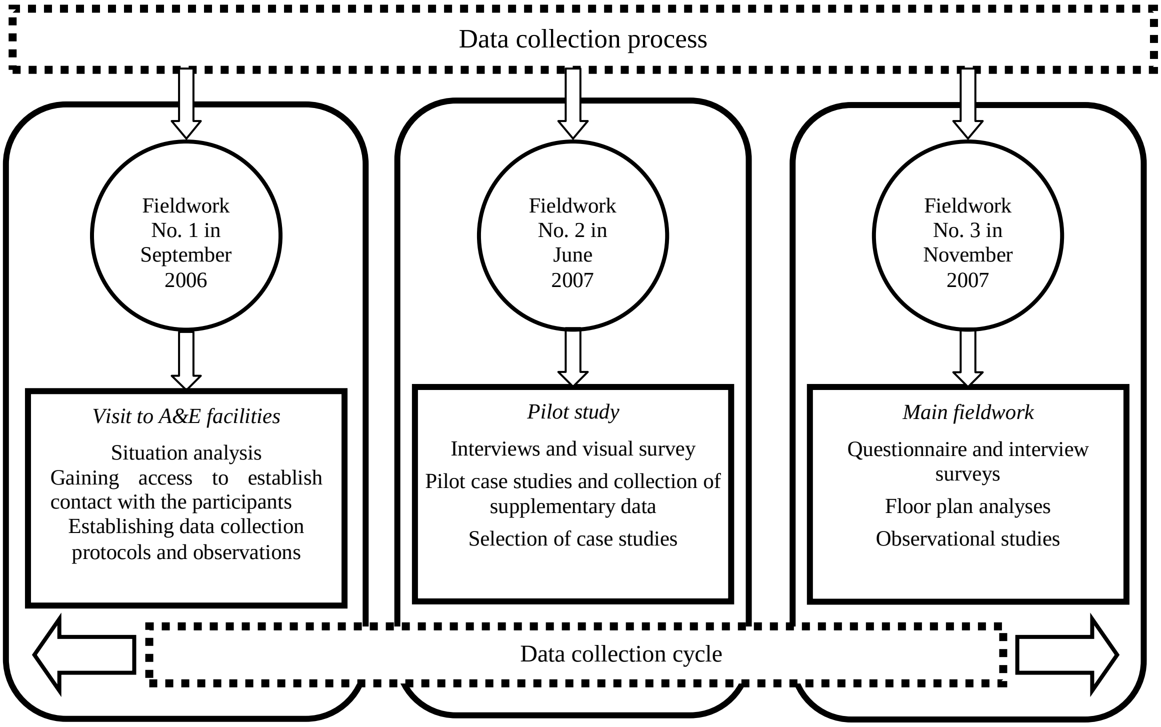


Figure 4.5: Data collection process phases

The first exploratory fieldwork trip, involved a situation analysis and establishing data collection protocols and observation. This second fieldwork trip, a pilot study, was to collect requisite information before the main fieldwork and also led to the development of the final questionnaire and interview instruments. It involved a multiple data collection strategy informed by the first trip, which highlighted the key issues that should be considered.

Finally, the information and data collected during the first and second fieldwork trips were comprehensively analysed and reviewed before embarking on the main fieldwork. The careful planning of the data collection processes, fieldwork phases and use of multiple study approaches were instrumental to the success of the study.

4.4.3 The research setting for data collection process

The choice of research setting, as Patton (2002) affirms, aims to facilitate data collection to answer the research questions (see Table 1-3). Two research settings were utilised for this study: Chris Hani Baragwanath Hospital (CHBH) in Soweto, Johannesburg and Pretoria Academic Hospital (PAH) in Pretoria, South Africa.

CHBH is located in Soweto,[24] Johannesburg. Established in 1904, as a township to house black labourers during the apartheid era, Soweto is the oldest product of segregationist planning. With over two million inhabitants, it is the most populous black urban residential area in South Africa. It has also been a hotbed political dissent—most notably, the 1976 student uprising.

CHBH was designed and built by the British in 1941 during the Second World War, as a healthcare facility for the British Imperial Army fighting in the Middle East. It is now a specialist referral institution serving about 3.5 million people from the Southern and Western parts of Gauteng Province, the majority of whom are blacks. It also receives referrals for specialist treatment from neighbouring countries. With 3,200 beds and 6,760 staff, and occupying 173 acres (0.70 km^2), CHBH is the largest hospital in the world (Price Waterhouse Coopers, 2002). The A&E facility is the busiest department of the hospital, providing 24-hour emergency services to a daily average 350 patients. Approximately 70% of the cases handled are trauma related—motor vehicle accidents, rape cases, murder and assault. The facility also treats an average of 160 victims of gun and other violent crimes per month (CHBH, 2006).

CHBH is a single-storey building with military barracks architectural concept as shown in Appendix A. The individual blocks, built of cement blocks roofed with corrugated iron sheets, are linked to each other through open covered naturally ventilated pedestrian walkways, in steel tubular structure with corrugated iron roofing sheets. The pedestrian and ambulance entrances are also in steel tubular structure with corrugated iron roofing sheets. The building design, materials and finishes used for the external architecture are environmentally unfriendly and institutional in character. The clinical zones (diagnosis, treatment and surgery) are directly linked to the nursing zones (in-patient areas) through the pedestrian walkways; and the support zones (ancillary and support spaces) are located off the pedestrian walkways.

[24] The acronym Soweto: made up from the first letters of the words “South Western Township” was chosen in 1963 after a four-year public competition during apartheid system in South Africa for the biggest black urban settlement in Africa with a rich political history.

Few new buildings have been added to the existing facilities at CHBH since 1941; but, periodic maintenance and minor renovation works have been carried out in several areas of the clinical and in-patient buildings by the Gauteng Provincial Government Department of Public Works. Other significant works include renovations works of the existing theatre complex by A3 Architects in 1995; and the new kitchen and general store, designed by the same architectural firm, in 1998 and 199 respectively. In 2001, Ngonyama Okpanum and Associates was appointed to renovate the existing A&E facility. A new master plan for the entire hospital prepared by Ngonyama Okpanum in 2009 is still under review by the Gauteng Provincial Government.

The second research setting was PAH, commissioned in March 2007. Built to provide the University of Pretoria, Tshwane University of Technology and SG Lourens Nursing College with a platform for training in various health disciplines, PAH serves a patient population of about 2,2 million, which includes the surrounding communities north of Pretoria and as far as Mpumalanga, Limpopo and North West provinces. It is the second most important referral hospital built by the current democratic government, the first being Inkosi Albert Luthuli Hospital Durban (PAH, 2006).

The DGs used for PAH were based on 'Minimalist Megahospital' principles (see section 2.6). PAH is a nine-storey building comprising two blocks with deep space floor plan linked to each other through suspended pedestrian walkways constructed of light weight steel structural elements. The structural frame is in reinforced concrete with light weight steel elements for the entrance roofs and A&E ambulance area. An environmentally sensitive approach to the building design and materials is less evident in this facility. Indeed, the external finishes of the building appear institutional. Being an academic hospital, the clinical zones for each of the specialists departments are directly linked to the corresponding nursing and support zones on the same level through the suspended pedestrian walkways.

The A&E unit provides 24-hour services to, on average, 220 patients daily, and is capable of treating various specialized medical and surgical emergencies. As in the case of CHBH A&E unit, approximately 80% of the cases handled are trauma related, such as motor vehicle accidents, rape, and assault (PAH, 2006). The two A&E facilities thus handle similar types of cases; but owing to its more extensive patient catchment area, average daily patient numbers are higher at CHBH A&E facility.

Selection of the research setting was based on the geographical spread and medical history of the patient population and analysis of the existing studies on the A&E facilities needs assessment in the area. In addition, the selection and choice of the data collection setting was also based on the analysis of the existing A&E facilities contextual circumstance and the use of DGAEF for their project development processes.

The distance between the two research settings is 100 kilometres, approximately an hour's drive. Their proximity facilitated fieldwork activity and enabled effective and efficient management of the limited available resources for the study. The information gathered in the preliminary fieldwork trips confirmed the appropriateness of the A&E facilities at both CHBH and PAH as settings for the study on DGAEF in South Africa.

4.5 Data collection methods

The data collection methods used for the empirical study were based on the tradition of inquiry used and their key purpose, as summarised in Table 4.3.

4.5.1 Literature review

There is limited published research on DGAEF; and that which is available is predominantly from the US or UK. Nevertheless, an extensive literature review was carried out to inform the study. The main objective was to establish current knowledge and research evidence on DGAEF, and gaps therein (see 4.2.2). The literature review included a computer search of several databases, and published and unpublished material, both print and electronic, from several sources, and was a continuous iterative process throughout the research.

Table 4.3: Data collection method, the tradition of inquiry used and the purpose

Data collection method	Tradition of inquiry used for data collection	Purpose
Literature search	Case study	To define and clarify the key dimensions and sub-dimensions (Gill and Johnson, 2002; Silverman, 2005); and to investigate the key issues constraining the review of the DGAEF
Questionnaire	Survey	To understand the phenomena through the meaning that people assign to them and their interpretation of how the subject of inquiry influences a particular situation within a context (De Vaus, 2002; Robson, 2002).
In-depth interviews	Case study	To gain rich descriptive information on the phenomena from all the key stakeholders (Creswell, 1998; Patton, 2002).
Floor plan analysis	Case study	To evaluate the physical environment in order to understand and gain knowledge on socio-spatial needs, space design and provision, functional suitability, spatial relationships and room dimensions (NHS Estates, 2004; Nuffield Provincial Hospitals Trust, 1957).
Observational studies	Case study	To observe, gather information on the research setting to understand the phenomena, in order to facilitate thorough data analysis and validation of the data collected from fieldwork (Miles and Huberman, 1994; Patton, 2002).

4.5.2 Questionnaires

One of the major strengths of the questionnaire method lies in its ability to provide essential information on the background and characteristics of a set of cases, thereby enabling direct comparison which is essential for thorough data analysis (De Vaus, 2002; Robson, 2002). The main purpose of using questionnaires was to collect quantitative information in order to understand and explain key issues regarding the use of the DGAEF for the development of A&E facilities.

Four sets of structured questionnaires were designed and used to obtain answers to the research questions from the following identified key stakeholder groups: National and Provincial Department of Health and Publics Works; Consultants; Caregivers; and Patients/Community (See Appendices C, D and E). The questionnaires were informed by the pilot studies, suggestions and comments from the researcher’s supervisors. A face-to-face approach was used to administer the questionnaires, which had closed-ended questions due to the technical nature of the study, and to shorten the questionnaire administration time and increase the response rate.

The questionnaires administered to the four respondent groups were similar in terms of structure and questions. The language for all was English. Language was kept as simple, clear and unambiguous as possible; but, the inclusion of some technical words was unavoidable.

4.5.3 In-depth interviews

In-depth interviewing was used to obtain supportive qualitative information that would be difficult to obtain by other methods. The in-depth interview sheet format and questions were similar to those used for the quantitative questionnaire survey. Similar questions were adopted for both the quantitative and qualitative approaches to enable confirmation or corroboration through triangulation (Miles and Huberman, 1994).

The interviews were conducted individually, guided by a detailed, coded interview sheet format (see Appendix F), and recorded through note taking. Feedback from the pilot studies discouraged the use of audio-recording equipment because of the ongoing debate amongst state officials and consultants on the topic. Note taking proved to be both acceptable and successful, and the interviews were subsequently analysed using content analysis (Miles and Huberman, 1994; Robson, 2002).

The semi-structured interview focused on the research aim and objectives and the key dimensions and sub-dimensions. Respondents were also probed on A&E facility problems and needs, and their evaluation of and level of satisfaction with the A&E facilities built environment.

4.5.4 Floor plan analysis

Floor plan analysis can measure and compare quantitative facts such as room dimensions and distances between spaces in the building. Qualitative evaluation of plans can also assist understanding and interpretation of the social and cultural links that exist among the different areas of the healthcare facility (Zeisel, 1981). Both quantitative and qualitative floor plan analyses were conducted in this study.

The floor plan configurations of the CHBH and PAH A&E facilities were evaluated using Link Analysis (LA), Hierarchical Task Analysis (HTA) and Space Syntax to determine the efficiency and effectiveness of space use and provision of support and ancillary facilities (Lu and Hignett, 2007), as described in more detail in Section 4.7.1. The quantitative floor plan analysis focused on the following areas: arrival/entrances; reception/waiting; triage and assessment; examination and treatment; short stay inpatient areas; patient and staff support areas; and circulation areas (NHS Estates, 2004).

Qualitative assessments of the physical environment were also made, structured according to the A&E facility zones. This approach helped in clarification and understanding of key qualitative research issues, including the interrelationships between the spatial environment and operational systems; socio-spatial needs; and socio-cultural implications in A&E facilities; and possibilities for improvement of A&E facility layout plans using Space Syntax techniques (Hiller and Hanson, 1984). The floor plan analysis studies helped to understand and explain how the DGAEF would assist to accelerate changes in clinical practice (Francis et al., 1999).

The LA, HTA and Space Syntax analysis were carried out at the two case study A&E facilities to record and analyse the movements and actions of the users, and in particular the caregivers and patients (see 4.7.1). These analyses helped the researcher formulate recommendations on the most efficient and effective ways to improve connections between different A&E spaces and operational functions through the DGAEF update.

4.5.5 Observational studies

Observation is an important qualitative data collection method. Indeed, it is acknowledged that there are limitations to knowledge gained through the analysis of data obtained from document analysis, surveys and interviews due to the validity and reliability of these methods (Denzin, 2000; Denzin and Lincoln, 2005; Gill and Johnson, 2002; Marshall, 2006; Miles and Huberman, 1994; Patton, 2002; Robson, 2002).

Observation was adopted to gain unobtrusive access to the research setting to observe the A&E daily operational activities, with specific attention on how the floor plan layout facilitates or constrains them. This technique also facilitated the assessment of other important issues relating to the physical environment such as: accessibility; quality of examination and treatment areas; noise level; way finding; distractions; and environmental comfort factors (e.g., lighting, temperature). The knowledge gained was critical to understanding and explaining the patients, caregivers, visitors and communities' needs.

Structured coding schemes were used to record environmental and behavioural categories for the observational studies to facilitate data analysis.[25] The pilot survey informed the semi-structured protocol for the specific user categories to be observed (patients, caregivers, family members and visitors). The continuous interval observation and recording technique was used to record the patient/caregivers/visitors interactions with the environmental and behavioural variables during A&E operations.

This approach enabled the collection of in-depth description of the A&E facilities spaces such as: sizes/shape of entrance areas, triage, examination and treatment spaces, staff and ancillary spaces. Detailed descriptions of the interactions between patients/caregivers/ visitors and physical environmental factors—such as natural light levels, colours, materials, equipment and furniture—were also collected. In addition, the researcher's flexible attitude allowed spontaneous dialogue and interaction with the A&E community, which helped in understanding the key design, functional and operational issues pertaining to A&E facilities that should be addressed in the DGAEF update.

[25] See Appendices J, K and L.

4.5.6 Behavioural mapping

Behaviour mapping is a systematic observation technique for recording the use of a specific space or location (Lehtonen et al., 2003). Behaviour mapping was used in this study to learn how the update of the DGAEF could facilitate the design of effective and efficient A&E spaces. Hence it was used to determine how to organise the spaces according to function, needs and activities, and where to locate furniture and equipment. It was also adopted to understand staff/patients/visitors workflow and social interaction processes for the update of the DGAEF. Behavioural mapping was conducted in conjunction with the observational studies in both A&E facilities.

4.5.7 Note-taking

Qualitative fieldwork generally collects information to answer research questions on “how,” “what,” “where,” and “who” is shaping the events under investigation through field-note descriptions, including jottings of one’s own psychological states, which helps develop comparative analysis with other research methods (Robson, 2002).

Note-taking is used to create and preserve a historical record of phenomenological and other research methodology. Writing notes enables the researcher, during fieldwork, to observe details; identify important information; record events and, in particular, details one is likely to forget; and create mental maps of events requiring further attention (Patton, 2002).

In line with Patton’s (2002) recommendations, observation and note taking were limited to three or four hours a day to retain fresh memories and allow time for writing-up. Sketches technique was used to enhance understanding about the effect of the spatial layout on users’ physical, cognitive and social experiences.

4.5.8 Exploratory visits and pilot studies

Exploratory visits and pilot studies of the CHBH and PAH A&E facilities in Johannesburg and Pretoria respectively preceded the actual fieldwork. The purpose of the exploratory visits and the pilot studies included the assessment of feasibility, efficacy and acceptability, of the study, and to identify strengths and weaknesses in the research plan in order to improve the main study. More specifically, the pilot studies were used to test the chosen research methodologies, to identify potential problems, and to explore ways of addressing them, in relation to the research design.

4.6 Implementing data collection methods

The main fieldwork commenced in November 2007, four months after the pilot study. This allowed sufficient time to gain more knowledge on DGAEF in relation to the research aim and objectives based on information gathered during the pilot study. It also allowed time for training of the research assistants, as described below.

4.6.1 Administration procedures

Before commencing the fieldwork research, formal approval was obtained from the research ethics offices at Wits University and Gauteng Department of Health (see Appendix T). Three research assistants with experience in healthcare facilities studies were then recruited and participated in the pilot study. The pilot survey thus enabled the researcher to test and revise the research instruments, in addition to enabling hands-on training of the research assistants. The training, which was conducted by the researcher, involved instruction in questionnaire administration, interviewing techniques, observational study methods, Hierarchical Task Analysis (HTA), Link Analysis (LA), AutoCAD and Space Syntax techniques (see 4.7.1).

4.6.2 Sampling methods

The goal of much research is to achieve statistical generalisation by using a sample that reflects a wider population (De Vaus, 2002). A representative sample can be obtained using different sampling methods. Two methods were used in this study—random and purposive sampling.

Random sampling, whereby any case in the sampling frame has an equal opportunity of inclusion, was used to select a representative sample for the questionnaire survey; while purposive sampling—whereby the researcher selects informants capable of providing the most pertinent information—was used to select respondents for the interviews (De Vaus, 2002; Neuman, 2006).

4.6.3 Sampling frame

The sampling frame for the study was obtained from CHBH and PAH statistical departments, South African Council for the Architectural Profession, Engineering Council South Africa, South African Council for the Quantity Surveying Profession and Gauteng Provincial Government. The sampling frames were obtained from the data available in June 2006, and are outlined in Table 4.4, Table 4.5, Table 4.6 and Table 4.7.

Table 4.4: Sampling frame of the consultant firms registered with Gauteng Province, June 2007

Type of consultant firms	Number of firms	%
Architectural firms in Gauteng Province	95	35.3
Civil/structural Engineering firms in Gauteng Province	93	34.6
Quantity Surveying firms in Gauteng Province	81	30.1
Total	**269**	**100.0**

Source: South African Council for the Architectural Profession, Engineering Council of South Africa and South African Council for the Quantity Surveying and Gauteng Provincial Government of Public Works.[26]

Table 4.5: Sampling frame for Caregivers in CHBH and PAH

Name of the hospitals	Number of staff	%
Chris Hani Baragwanath Hospital - A&E Department	291	64.1
Pretoria Academic Hospital – A&E Department	163	35.9
Total	**454**	**100**

Source: Data obtained from the CHBH and PAH Statistic Departments, June 2007.

[26] Only those firms registered with the Gauteng Provincial Government of Public Works are considered for this study.

Table 4.6: Sampling frame for A&E Patient/Community in CHBH and PAH

Name of the hospitals	No. of patients per day	% of total
Chris Hani Baragwanath Hospital - A&E Department	350	61.4
Pretoria Academic Hospital – A&E Department	220	38.6
Total	**570**	**100**

Source: Data obtained from the CHBH and PAH Statistic Departments, June 2007.

Table 4.7: Sampling frame for Gauteng Department of Health and Public Works, Gauteng Province

Name of the Department	Number of staff	% of total
Gauteng Department of Health	67	47.5
Gauteng Department of Public Works	74	52.5
Total	**141**	**100**

Source: Data obtained from the staff list of the Gauteng Provincial Government, June 2007.

4.6.4 Sample size

The representative sample size depends on the two key issues; the degree of accuracy required and the extent of the variation of the cases with regard to the key research dimensions (De Vaus, 2002).

Informed by the pilot survey, random sampling was used to select the sample size of different group categories through the allocation of random numbers. The sampling sizes obtained for the questionnaire surveys and interviews are outlined in Table 4.8 and Table 4.9.

Table 4.8: Sampling size used for the questionnaire survey

Categories	Sampling method	Sample frame	Sample size	%
Consultants	Random	269	100	37
Caregivers	Random	454	300	66
Patients/Community	Random	570	200	35
Dept. of Health/Public Works	Random	141	100	71

Table 4.9: Sampling size used for the interviews

Categories	Sampling method	Sample frame	Sample size	%
Consultants	Purposive	20	10	50
Caregivers	Purposive	30	20	67
Patients/Community	Purposive	30	20	67
Dept. of Health/Public Works	Purposive	20	10	50

4.6.5 Questionnaire administration

Meetings were organised in November 2007 to administer the questionnaires to the different categories identified for this study (see 4.5.4). Meetings with the government officials were held between 07:30 am and 08:30 am, before the start of their usually busy daily schedule. To ensure that questions were answered correctly, the researcher or research assistant waited for the respondent to complete the whole questionnaire. This enabled respondents to obtain immediate clarification on unclear questions. In some cases, respondents were left with the questionnaires to give them ample time to obtain accurate information to answer some of the questions, such as the timeframe for completion of A&E facilities and the cost of the construction of level 1, 2 or 3 A&E facilities. The information obtained after daily fieldwork was analysed and used to improve the next day's activities.

Notwithstanding, this strategy, there are still some missing data in the completed questionnaires. Indeed, some completed questionnaires were removed owing to missing data or lack of interest from respondents to increase the reliability of the data obtained. Out of the 100 questionnaires administered to this category, 78 were completed correctly.

The questionnaires were administered to the consultants in the evenings, after normal working hours. The respondents in this category completed the questionnaires with ease owing to their level of education and knowledge in this field, although some had difficulty in answering questions relating to construction costs of A&E facilities. Of the 100 questionnaires administered, 81 were completed, giving a response rate of 81%.

The questionnaire for the patients and caregivers were administered last owing to the difficulty in gaining access to these categories of the respondents. Background information of the patients was obtained from the hospital records department and by the time of the survey some had changed their details. This is because many patients are migrant workers; and is one of the limitations of using random sampling. To overcome this problem, the researcher and research assistants attended Soweto development forum meetings generally held at 10h00 am on Sundays to locate some of the respondents. Out of the 200 questionnaires administered to the respondents, 173 were completed, yielding a 86.5% response rate.

Administering questionnaires to the caregivers presented problems because of the nature of A&E operations and difficulty in arranging appointments with them. This problem was overcome by obtaining home details of some of the caregivers and arranging for the questionnaires to be delivered and collected when completed. A total of 300 questionnaires were administered to this category and 204 were completed—a 68% response rate

In summary, questionnaire administration was a challenging task as outlined above. However, the overall results are considered satisfactory. Out of 700 questionnaires administered, 556 were completed satisfactorily—a response rate of 79%.

4.6.6 Conducting of interviews.

The interview setting needs careful consideration as it influences the mood of the dialogue between the interviewer and the respondent. Interviews in the present study were conducted in various settings in December 2007 and January 2008.

Some of the government officials preferred to be interviewed early in the morning in their offices at the same time the questionnaires were administered. Others were interviewed at their homes, and others still at the researcher’s office. Of the ten interviews originally planned, only six were successfully completed, partly due to changes in the top management during fieldwork and the busy schedules of the government officials.

The consultants were interviewed at their offices in the evenings because it would have been difficult to have their full attention during normal working hours. The interviews lasted for about two hours; but of the ten planned only five were successfully completed due to the respondents’ time constraints. Two of the consultants interviewed designed CHBH and one was the architect for PAH.

The interview setting for the caregivers provided the researcher a good opportunity to observe how A&E staff areas are used, which would otherwise not have been possible because access is restricted to staff members. The respondents in the representative sample were selected to reflect all disciplines, including physicians, nurses, administrators and medical allied workers.[27] Ten interviews were conducted with the caregivers out of the 20 planned: five caregivers were interviewed on both CHBH and PAH respectively.

A representative sample comprising ten female and ten male patients that had recently visited the two A&E facilities was obtained from the statistical department for the interviews conducted during February 2008. The patients were contacted and invited to the respective A&E facilities for the interviews. Some, however, refused to come to the hospital for the interview, preferring alternative settings. Ten patients were successfully interviewed—six from CHBH and four from PAH. Several informal interviews were also conducted with various individuals, the results of which were coded and documented as supportive evidence.

A total of 31 of 60 planned interviews were successfully conducted. The qualitative interview data was used to, check, confirm and reinforce the findings from other methods used in the study.

4.6.7 Observational studies and behavioural maps

Observation method

The multiple observations method used in this study involved shifting the observation points within the respective A&E facilities in order to observe and map behavioural patterns. Five and eight observation points were used in the CHBH and PAH A&E facilities respectively (see Chapter Six, Figure 6.6 and Chapter Seven, Figure 7.5). The selected observation points enabled the researcher to observe and record unfolding events; ongoing

[27] The completion of the interview survey with the caregivers lasted several days because they were constantly interrupted in order to attend to the patients. In some cases the interview has to be postponed to the next available time and day, depending on their daily workload. The maximum duration of time agreed with the Director of A&E Department was two hours regarded as a reasonable time for the interview although the interview length varied with the respondents. Some were very happy with the research and exceeded the allowed timeframe with the researcher.

traffic of patients, family members, and caregivers; and handling of equipment and medicine. The information collected informed the analysis on how DGAEF influence the integration of A&E spaces and operational processes.

Observation times

Observation times were based on the eight hour daily shifts of caregivers in A&E facilities split into five observation times to enable continuous observation, as shown in Appendix K. The purpose of these different observation times was to see if there are any substantial differences in day- and night-time activities and behaviours

The observation period for CHBH was from 7 to 31 January 2008. The researcher initially aimed to record 500 and 250 observations in the CHBH A&E and PAH A&E facilities respectively; but this number was reduced to 100 and 50 respectively owing to the complexity of A&E functions and to allow time for informal interaction with the users.

Observation categories

The observations were carried out at 20-minute intervals and recorded on the continuous interval recording sheet. Particular attention was paid to how the A&E facility layout plans address issues relating to key built environmental variables such as noise pollution due to the materials used, equipment noise and human noise; air quality and ventilation and lighting levels; positive distraction in the staff and patient units; the position of the windows and plants; and whether there was music and art works on the walls. Patient and family control of the lighting level, temperature and access to print and electronic information sources were also observed and recorded, as were interaction with other built environmental variables like family support areas and caregiver's areas.

Behavioural Mapping

The behavioural maps were recorded from the same points that the observations were made, and included recording the behaviour and interaction of caregivers, patients, family members and visitors. Movements of medical supplies and equipment, and use of furniture were also recorded. The behavioural maps furthermore facilitated analysis and formulation of recommendations pertaining to common challenges faced by most of A&E facilities in South Africa, such as waiting times; lack of privacy and dignity for patients; wayfinding; violence towards staff; and criminal behaviour and damage to property.

A total of 60 behavioural maps were recorded in the two A&E facilities between 7:00 am and 7:00 pm over a period of ten working days in January and February 2008.

4.6.8 Floor plan analysis

The data collection approach for the floor plan analysis conducted during the observational studies used the key performance indicators (KPIs) developed by NHS (2001): baseline statistics; pattern of movement survey; space use occupancy survey. The floor plan analysis was undertaken to evaluate how the provided spaces are being used for healthcare delivery services, and to assist the researcher to evaluate built environmental features that would improve or constrain the effectiveness and efficiency of the A&E facility daily operations.

Floor plan analysis using baseline statistics

A baseline survey was conducted to evaluate the impact of the DGs used for the floor layout plan on handling of A&E cases such as trauma related accidents. It included evaluation of the as-built positions and dimensions of all functional spaces, so as to assess the flexibility and adaptability of the floor plan configuration, with respect to fitness for current purpose and use for other purposes than originally planned. Additional relevant data and information on the guidelines used for their design were also obtained to facilitate comprehensive comparative analysis. The floor plan analysis was conducted in parallel with the observational studies for two-weeks in each of the case study A&E facilities (see Appendix I).[28]

[28] The fieldwork activity was conducted primarily during the caregivers morning shift which is from 6.00 am till 3.00 pm . The baseline statistics were manually recorded on the existing floor plan and all relevant data such as date, survey time and codes were recorded on the

Floor plan analysis using pattern of movement technique

The pattern of movement technique, a key design performance indicator, is based on the number of visual steps it takes to get from one point to another within the building (NHS Estates, 2004). This method can provide accurate information on the navigability of the built environment. It was adopted to study the movement pathways and journey times of caregivers/patients/family members/visitors from the time they enter the facility to their multiple destinations daily. Information on whether patients were recumbent or ambulatory; was also collected.

Pattern of movement surveys were conducted in both A&E facilities in January and February 2008 over a period of ten days, during peak and non-peak days.[29] This data collection strategy was used to evaluate challenges facing A&E facilities such as wayfinding, patient privacy and dignity, long waiting times for patients and visitors and caregiver's surveillance of the waiting and in other areas inside the department.

Floor plan analysis using space use occupancy survey

Space use occupancy data was collected at the CHBH and PAH A&E facilities every weekend during the same period of the observational studies in January/February 2008. The techniques used were entrance and exit counts; space occupancy surveys and room profiles.[30]

Entrance and exit counts: The flow of caregivers, patients, family members and visitors through the A&E facility was calculated by physically counting the number of people passing through the entrances, exits and corridors.[31] Using the space occupancy continuous

observation time sheet. Observation continuous interval recording sheets were also used to record other details observed, for example, the positions of the equipment, furniture and medical artefacts. These data were also recorded on the floor plans by simply sketching their physical position and the pattern of the movement of this medical equipment in the observed zone inside the department.

[29] This observation was carried out during the morning shift which starts from 7:00 am till 3:00 pm when the shift handover was complete. Each caregiver and randomly selected individuals present in the morning shift were followed during one complete tour of the duty or their excursions. This exercise was also randomly done during afternoon and night shifts to enable generalisation during data analysis.

In CHBH, 1,967 journeys from one point to another were made between caregivers and the people present in the department during the observation period which lasted for five days, while the average daily distance travelled in performing their duties during their shift was 2.5 kilometres. The corresponding figures for PAH were 1,690 and 2.0 kilometres.

[30] This survey was carried out in the evening from 4 pm when the shift handover was complete till 7 pm. This period was selected based on information on patient attendance numbers and peak daily workload.

[31] The entrances and exits considered included those leading to departments adjacent to the A&E unit such as radiography, laboratory, operating theatres and short stay wards.

interval recording sheet (see Appendix L), the movement of people was recorded by entering the number of individuals entering or leaving the facility every 20 minutes to determine the peak and off-peak periods. The floor layout plans of the A&E facilities were used for the survey protocol for the fieldwork activity.

Space use occupancy and room profiles survey: The space occupancy and room profile surveys were conducted simultaneously during the observational studies to obtain information on the utilization of spaces within the A&E facility each day. The space occupancy survey was carried out using a "static snapshot" technique, whereby the researcher walked through the department once every 20 minutes recording the following information (NHS Estates, 2004):

– occupied and vacant spaces;
– the number and category of the people (caregivers, patients, family members/visitors) present in each space;
– the number of people present in the waiting area;
– the exact location of individuals in the A&E unit;
– the location of equipment., trolleys and wheelchairs both occupied and vacant;

The space occupancy survey was done during weekends in January and February 2008.[32] A total of 270 and 220 space use surveys were recorded in CHBH and PAH A&E facilities respectively.

The room profile survey was conducted and recorded on the space occupancy continuous interval recording sheets (see Appendix R). It involved collecting information on the use of the key A&E department areas such as minor and major examination and treatment areas, and the resuscitation area. It also included detailed observation of the tasks performed by the caregivers. The purpose was to identify and understand the space, personnel and

[32] Three days every week was used for recording this survey on each of the A&E facilities. In January 2008 space occupancy survey were conducted in A&E unit at CHBH and in February 2008 at the facility in PAH.

equipment needs for various healthcare processes, which will assist in establishing the ideal area for A&E operations and support spaces for caregivers/ patients/family members/visitors.

The room profile survey was carried out using a “continuous interval observation technique” which requires the researcher to observe events unfolding in different rooms (NHS Estates, 2004). The times when the caregivers, patients, family members and visitors enter specific rooms where recorded on the space occupancy continuous interval recording sheets. The data collected includes medicines, supplies, linen, food, and equipment.

The floor layout plan was also used to record the areas occupied by the caregivers and patients and detailed information regarding the positioning of equipment.

The room profile surveys were conducted in January and February 2008 in both A&E units. The knowledge gained was used to compare various simulation scenarios and subsequently to inform guiding principle for the update of the DGAEF.

4.7 Data analysis procedure

Data analysis was based on the three research traditions used for the study—phenomenology; case study and survey (Creswell, 1998; Robson, 2002)—as summarised in Table 4.10. The three research traditions proceed systematically from empirical data collection, analysis and management (Stake, 2005).

The researcher first described the research setting, the meaning and the objective impact of the phenomena observed. The individuals experience about the topic of inquiry was analysed and the lists of significant statements were categorised and grouped into similar units. The interpretive and reflective analysis of the data collected was used to describe what was observed, seeking all possible meanings and divergent perspectives about the phenomena.

Table 4.10: Data analysis procedure and the three research traditions

Data analysis procedure	Observational studies	Survey/Interviews
Data management	Data collected were filed and recorded using pre-specified coding system for each data collection method	Data collected were filed and recorded using pre-specified coding system for each data collection method
Coding and memoing	Initial analysis of the data collected was done, key themes were noted and code using pre-specified coding system	Initial analysis of the data collected was done, key themes were noted and code using pre-specified coding system
Description of the research setting and the unfolding event	The meaning and the objective impact of the phenomena observed was described	The case study, the setting and the meaning of the phenomena observed were described
Display data	Identify individual statements meaning and group them into units	Identify individual statements meaning and use categorical aggregation then group all into similar units
Interpreting	Analysis of the data collected was used to describe what was observed, how the event unfolded and the experience of the researcher.	Analysis of the data collected was used to describe what was observed, how the event unfolded and the experience of the researcher so as to enable generalization.
Representing and visualizing	Describe the event observed and experience gathered using tables, figures and meaning of the key themes and statements noted	Describe the event observed and experience gathered using tables, figures and meaning of the key themes and statements noted
Conclusion	Note patterns of themes, statements to build logical chain of evidence and limitations encountered during and after the research	Note patterns of themes, statements to build logical chain of evidence and limitations encountered during and after the research

Source: Adapted from Creswell (1998)

The data recording and coding system were pre-specified on different fieldwork data collection protocol sheets to enable effective and efficient data collection and analysis process (see Appendices L and O). The quantitative data was processed using statistical package for social sciences (SPSS) and computer software programme Excel. Analysis of variance (ANOVA) at the 5% significance level was undertaken to test the findings and identify whether the respondent groups' (consultants, caregivers, government officials and patients/community) opinions and views regarding some variables and aspects of the DGAEF were similar. The ANOVA and Chi-Square tests enable survey findings to be tested statistically, and clarify the differences between mean values of survey categories, thus, allowing conclusions to be drawn (see Appendices M and N).

Space syntax techniques used software programme Depthmap to examine the relationship between components of the A&E floor plan spaces (Hiller and Hanson, 1984), as described in Section 4.7.1.

The qualitative empirical data collected from the observational studies, behavioural mapping and interviews was analysed using content analysis, coding, memoing sorting and writing. After completion of the initial data management procedures, coding and memoing, the key themes were noted according to the pres-specified systems. Detail analysis of the event observed and the experienced gained was described using tables and figures to illustrate the meaning of the key themes and statements. Finally, the researcher developed naturalistic generalization from the data analysed by noting the patterns of themes, statements to build logical chain of evidence and the limitations encountered during and after the research.

Additionally, SWOT (strengths, weaknesses, opportunities and threats) analysis is used to identify the strengths and weaknesses of, opportunities for and threats to the DGAEF.[33]

4.7.1 Procedure for floor plan analysis

The empirical study on the A&E floor plans yielded extensive data on configuration. topology and visual characteristics, which were analysed in relation to A&E built environment variables (see 4.3.1.2). Hierarchical Task Analysis (HTA), Link Analysis (LA), AutoCAD, and Space Syntax techniques were used for the analysis of the A&E floor plans.

Hierarchical Task Analysis (HTA) and Link Analysis (LA)

Hierarchical Task Analysis (HTA) is a technique used to analyse data on daily activities within the A&E facility. HTA was used to divide A&E operations task into sub-tasks until caregivers tasks cannot be further broken, that is when all typical daily workload has been exhausted. This analysis includes how they accomplished their tasks in the minor and major examination/treatment areas, resuscitation areas and clean-utility/dirty-utility rooms and in all other support areas.

Link Analysis (LA) is a technique used to record the following daily activities within A&E facility: movements of components, (equipment/device and furniture); movements

[33] See 8.3 and Tables 8.4, 8.5, 8.6, 8.7, 8.8 and 8.9.

among caregivers within the facilities with the components (equipment/device, furniture) and the movement of the patients/family members/visitors according to the information noted observation continuous interval recording sheet. LA was used to analyse the movement of people, equipment and furniture within the A&E facility.

AutoCAD

AutoCAD was used to communicate spatial information for testing the effectiveness and efficiency of the actual space provided, and similarly used to facilitate analysis of the data obtained from HTA, LA and Space Syntax techniques.

Space Syntax

The space syntax technique was used for the analysis of the floor plan layout. The reasons for using this non-discursive technique[34] were twofold: to enable understanding and translation of A&E operational requirements into the physical form of spatial arrangement; and to recognize the potential of the built form in facilitating specific organisational operation. Space syntax was also used to evaluate the key built environmental variables such as wayfinding and surveillance of patients, especially in waiting areas.

A key space syntax technique used for floor plan analysis is visibility graph analysis. The visibility graph analysis (VGA) is a combination of isovist fields with space syntax technique to provide a measure of how well the relationship between sight lines through a given space corresponds with the movement pattern of the people within the same space.

The computer software used for visibility graph data analysis is Depthmap. The VGA data analysis is done using Depthmap to overlay grid of points on the floor plan, then a graph is drawn connecting every point that can be seen. The visual integration of a point is based on the number of visual steps it takes to get from that point to any other point within the building. This data analysis method was used to evaluate challenges facing A&E facilities such as

[34] A non-discursive technique refers to the way spaces are laid out. The spatial layout configuration is, therefore, described in terms of the pattern of connections between defined units of space. It does not deal with metric distances, but with topological values (Hiller, 1996)

wayfinding, patient privacy and dignity, long waiting times for patients and visitors and caregiver's surveillance of the waiting and other areas inside the department.

4.7.2 Analysis of Observational Studies, Behavioural Mapping and Interviews

As mentioned above (see 4.7), the qualitative data were analysed using content analysis, coding, memoing, sorting and writing strategies.

Initial transcription and content analysis

On completion of the daily fieldwork for observational studies, behavioural mapping, interviews and other supportive research activities, fieldwork notes and protocol documents were updated immediately. The strategy of initial transcription and data analysis was necessary in order not miss any detail of the event observed and recorded.

The coded field-notes and other fieldwork protocol documents—observation location and times sheet; observation continuous interval recording sheet; and space use occupancy continuous interval recording sheet—were read thoroughly as required by the content analysis approach. Through this data analysis technique, the ideas, opinions, themes, issues or hidden assumption are extracted from the text.

Coding and memoing

Coding is a systematic data display technique that facilitates constant comparison between different codes of the data collected and enables the researcher to move further than the empirical level (Creswell, 1998). Pre-specified codes were defined and used for the data collection protocol sheets based on the information obtained from the pilot study.[35] Memoing is used to develop ideas on categories by theoretically coding the properties of substantive codes, and drawing and filling out analytic properties of the descriptive data (Glaser and Holton, 2004).

[35] Constant comparison between codes makes it possible to put together substantive codes under more broad conceptual codes. Thus, substantive codes relates to objects and events, conceptual codes integrate these on a higher level of construct and let the researcher move further than the empirical level (Creswell, 1998)

Iterative coding and memoing, were used for the qualitative data analysis and to refine results. Thus, data entry was multiform, including short blocks of text, quotes, phrases, ratings, abbreviations, symbolic figures, labelled lines and arrows. The data display formats were according to the information required to address the research problem, aim, objectives and the questions (see Appendices C, D and E).

Sorting and writing

Sorting is a method for managing the codes, memos and the information collected from their analysis—key themes, statements and the experience gathered by the researcher (Creswell, 1998; Miles and Huberman, 1994). Hence the key themes identified from the qualitative data analysis were categorised into three main issues:

(i) Design tools: project brief document, design solutions, project management, and project programme;

(ii) Quality of the physical environment; and

(iii) Perceived perceptions.

These issues were categorised and tabulated, and are discussed further in Chapter 5.

The qualitative data analysis techniques described above were also used for the analysis of the data collected through other supportive research activities.[36] The key themes and statements that emerged were categorised as above. The findings provide evidence for recommendations on how to address the issues constraining the design of effective and efficient A&E facilities.

[36] The observations recorded on notes and fieldwork protocol sheets during A&E tours, the informal interviews with the academics, medical students, construction industry and other participants were also extracted, analysed and displayed as above. The project design and construction phase minutes of the meetings collected from the architects offices involved in the design and construction of the two case study A&E facilities used were also analysed based on the above techniques.

4.7.3 Procedure for analysis of the questionnaires

Classifying completed questionnaires

Classification imposes order to data collected from questionnaires and influences what is analysed. It thus has a direct impact on findings from the data collected through questionnaires (Creswell, 1998; Robson, 2002). The classification system for the questionnaire data analysis was developed after completion of the questionnaires. To ensure that the data collected from questionnaire responses were valid and within statistical standard, they were classified as follows:

(i) responded according to the questions;

(ii) responses with missing cases;

(iii) refused to answer the questions;

(iv) uncompleted questionnaires or no contact with the respondent.[37]

It was not, however, possible to administer questionnaires to some of the randomly selected respondents (see 4.6.4). Indeed, conducting any empirical study in a healthcare environment is not an easy task, particularly in an A&E unit owing to the nature of A&E and trauma cases.

Response rates for the questionnaires

The most common criteria for judging any research is the response of rate achieved in relation to the number of the questionnaire administered. The response rate is dependent on a number of factors, such as the topic, the nature of the representative sample, the length of the questionnaire and the data collection procedure (Creswell, 1998). The data collection approach adopted in this study proved appropriate given the overall response rate achieved, as detailed in Chapter Five.

[37] Respondents who completed their respective questionnaires correctly were categorised as "responded according to the questions". Completed questionnaires with a maximum of five missing data were displayed under the term "responses with missing cases". Respondents who were unable to answer questions owing to lack of knowledge in the research topic or had no opinion on the subject were referred to as "refused to answer the questions". The technical nature of the study is one of the limitations of using the questionnaire method for data collection particularly for the patient/community category.

4.8 Challenges faced and limitations of the research methods

The key challenges faced and limitations of the research methods:

(1) The timing of the survey fieldwork coincided with the reshuffling of the Gauteng Provincial Legislature Members of the Executive Council and the Director Generals of the Department of Health and Public Works respectively;

(2) The random sampling technique used in for the selection of the patient group for the two research contexts, selected some of respondents without their new contact detail;

(3) Very limited literature on theoretical and empirical studies on DGAEF;

(4) Conducting surveys within the A&E units was very stressful for both the caregivers and the researcher owing to the nature of the work. However, a good response rate was achieved, despite some participants initially being reluctant to participate.

To address the above challenges, the researcher developed appropriate strategies, which included:

(1) Organising informal meetings with the Government officials at the offices of the researcher. This strategy enabled the researcher to arrange one-to-one interviews.

(2) Attending the community development forums usually held on the first Sunday of every month in the townships; and inviting participants to the A&E facility they attended for interview and completion of the questionnaires.

(3) Falling back on the substantial knowledge about A&E facilities gained by the researcher through his involvement in their design in South Africa.

(4) Studying the tasks to be performed by the caregivers on the arrival of A&E cases during interview and completion of the questionnaires and learning the caregiver's code for classification of the cases, and thereby being able to predict the treatment time.

Participant observation, behavioural mapping and floor plan analysis were also conducted depending on the type of A&E case in attendance by the caregiver. In some difficult cases, another tactic used was to get the caregiver's home address, and deliver the uncompleted questionnaires and then collected it from either the A&E facility or the home address.

The prior knowledge gained before conducting the fieldwork enabled the researcher to organise the daily programme so as to avoid unnecessary loss of time owing to the nature of the A&E environment.

4.9 Summary and conclusion

Table 4.11 summarises the challenges and problems that arose in conducting the empirical research and the strategies adopted to overcome them.

Table 4.11: Summary of the challenges, problems, key strategies and themes

Identified problems	Key strategies	Themes
Geographical and physical characteristics of the study context	Attending informal community meetings	Government policy
Political, social, economic and cultural circumstances of the study context	Develop comprehensive communication tools to explain the importance of the study	Government policy
Timing of fieldwork survey during Gauteng Provincial Legislature Members of Executive Council reshuffling	Use previous good relationships with government gain access to information	Government/institutional
Very little previous information and data on the study	Required using multiple research strategy to gain access to more empirical information and data	Political/social/cultural/economic issues
Doing fieldwork survey in A&E facility	Knowledge of A&E non-urgent and urgent cases classification	Healthcare institutional culture
A&E facility operations	Knowledge of A&E workflow processes and spaces required for medical attention to patient	Healthcare institutional culture
Financial circumstances	Detailed study plan, management, continuous monitoring of study resources and time	Cultural and economic issues

5 CHAPTER FIVE

DGAEF IN PRACTICE: USERS' VIEWS AND OPINIONS

5.1 Introduction

This chapter presents the findings of the questionnaire surveys conducted at the two case study A&E facilities at Chris Hani Baragwanath Hospital (CHBH) and Pretoria Academic Hospital (PAH) respectively.[38] The results are based on participants' responses. Analysis of variance (ANOVA) and Chi-Square tests were also performed to investigate statistical significance between participants' responses where appropriate.[39]

This chapter has five main sections. The first presents the profiles of the respondents. The second and third sections respectively present the respondents' views on the DGAEF and on their update based on Planetree principles. The subsequent two sections present the respondents' perceptions and opinions on obstacles to the use of, and compliance to the DGAEF. The chapter ends with a summary and concluding remarks.

5.2 Profiles of the respondents

Pertinent information about the respondents was gathered by asking questions related to gender, age, home language, educational background and work experience.

5.2.1 Gender, age and home language of the respondents

The consultants and government categories are predominantly male, while the caregivers and patient categories are dominated by women. These findings are presented in Table 5.1, and are consistent with those of Anderson (2008). Likewise, according to Statistics South Africa (2009), the percentage of males employed in the government and built environment offices is considerably higher (65.5%) than that of women (34.5%). While the

[38] See Appendices C, D and E.

[39] See Appendices M and N.

consulting firms and government sectors are dominated by males, the majority of healthcare workers are female. Therefore, it is plausible to conclude that there was no gender bias in the information obtained from this study.

Table 5.1: Gender of the questionnaire respondents

Gender	Consultants n=81(%)	Caregivers n=90 (%)	Government n=78 (%)	Patients n=93 (%)	Overall n=342 (%)
Male	60.5	19.6	73.1	35.3	37.9
Female	39.5	80.4	26.9	64.7	62.1
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 5.2 shows that the majority of the 342 respondents are between 36 and 45 years. The consultants, caregivers, government officials and patients mean ages are 30.8, 35.0, 38.5 and 30.2 years respectively; and the overall mean age is 33.44 years. This result is consistent with figures obtained from Statistics South Africa (2009).

Table 5.2: Age distribution of the respondents

What is your age?	Consultants n=80 (%)	Caregivers n=90 (%)	Government n=78 (%)	Patients n=93 (%)	Overall n=342 (%)
25-35 years	19.7	21.0	20.5	16.4	19.4
36-45 years	24.5	26.6	28.1	25.4	26.2
46-55 years	21.4	22.3	23.7	26.0	23.4
56-65 years	18.6	16.8	17.4	18.7	17.9
66 & above	15.8	13.3	10.3	13.5	13.2
Mean Age	**30.8**	**35.0**	**38.5**	**30.2**	**33.44**

The three main languages used by the consultants group are English (19.8%), IsiZulu (19.8%) and IsiXhosa (11.1%). The main languages used by the caregivers are English (21.0%), Afrikaans (16.5%), IsiZulu (14.3%) and IsiXhosa (8.9%); while the government officials use English (20.5%), Afrikaans (14.1%) and IsiZulu (10.3%). The three main languages used by the patients are IsiZulu (26.0%), English (10.4%) and IsiXhosa (8.7%).

Overall, the most used languages amongst all the respondent groups were IsiZulu (17.7%), English (17.4%), Afrikaans (11.5%), and IsiXhosa (9.4%). These findings are consistent with the Statistics South Africa (2001) census report findings.

5.2.2 Educational background and work experience in the organisation

Table 5.3 presents the respondents' educational backgrounds, and shows that, overall, 41.1% (185) hold diplomas and 38.1% (131) have university degrees. These findings are consistent with the Statistics South Africa (2001) data on the educational qualifications of the actors in this field. Most of the respondents in the caregivers group, 51.9% (46), have a diploma, with only 32.9% currently having a university degree. The proportion of respondents from the patient group who had acquired higher educational qualifications (49.3%) was relatively low compared to the other groups. The latter finding is in line with the information obtained from the CHBH (2006) and PAH (2006) Statistics Departments.

Table 5.3: Educational level of the respondents

What is your educational level?	Consultants n=77 (%)	Caregivers n= 90 (%)	Government n=78 (%)	Patients n=93 (%)	Overall n=342 (%)
Under Primary Certificate	0.0	0.0	0.0	0.0	0.0
Under Secondary Certificate	0.0	0.0	0.0	0.0	0.0
Secondary Certificate	0.0	15.2	15.1	50.3	20.8
Diploma	41.6	51.9	39.7	31.4	41.1
University Degree	58.4	32.9	45.2	18.3	38.1
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

To obtain detailed information on the respondents’ work experience in the organisation, the following information was solicited: professional qualifications; membership of professional associations; current position in the organisation; and number of years in the current position. The findings are presented in Table 5.4, and show that the majority of the consultants, 25.9% (20), have over four (4) years of experience. Most of the caregivers, 27.1% (60), have over ten (10) years of experience, while 37.2% (29) in the government officials group have three (3) years or less.

The mean length of experience of the respondents in their respective fields was 3.5, 6.2 and 5.2 years for consultants, caregivers and government officials respectively. These results indicate that the consultants group have staff with relatively few years of experience in their respective organisations compared to the caregivers and government officials groups. The information gathered through the in-depth interviews supports these findings (see 6.1 and 7.1). In comparing the average years of experience of the three stakeholder groups, an ANOVA test at 5% significance level showed statistically significant differences (F ratio is 7.085 and p-value is 0.001). This would imply that those with relatively few years experience in the consultants and government officials groups are likely to also have limited experience in the interpretation, translation and application of the DGAEF.

Table 5.4: Work experience in the organisation

How long have you been in this position?	Consultants n=80 (%)	Caregivers n= 90 (%)	Government n=78 (%)	Overall n=248 (%)
Under 1 Year	13.6	3.7	0.0	5.77
1 to 2 Years	7.4	14.1	2.6	8.03
25 months to 3 Years (36 months)	21.0	14.0	34.6	23.20
37 months to 4 Years (48 months)	25.9	11.3	17.9	18.37
49 months to 5 Years (60 months)	21.0	14.0	16.7	17.23
61 months to 10 Years	8.6	27.1	17.9	17.87
More than 10 Years	2.5	15.8	10.3	9.53
Total	**100.0**	**100.0**	**100.0**	**100.0**

5.3 Respondents comments on the DGAEF

The findings on A&E facilities built using the DGAEF were based on the respondents' answers to a set of questions investigating the following issues: experience with A&E facilities designed using the DGAEF; knowledge and use of, and level of compliance with the DGAEF; the influence of the DGAEF on achieving healthcare facilities development goals; the influence of the DGAEF on technology innovation; and finally, the influence of the DGAEF on standardisation of the overall project development process.

5.3.1 Experience with A&E facilities designed using the DGAEF

The results of this investigation were based on the respondents' answers to the following questions: attendance to A&E facility; type of A&E facility visited; means of transport; distance travelled; travel time to the A&E facility; and level of satisfaction.

Table 5.5 shows that, overall, 78.5% (437) of respondents or their family members had used an A&E facility in the past 12 months. This result is consistent with data obtained from Gauteng Department of Health Statistics Office (2008). Table 5.5 shows that caregivers and patients groups attendance to A&E facilities was relatively high—95.6% (86) and 97.1% (90) respectively—when compared to consultants and government officials groups—59.3% (81) and 57.7% (45) respectively.

Table 5.5: Attendance to A&E facility

Have you or a family member ever been to an A & E Facility for medical treatment in the past 12 months?	Consultants n=81 (%)	Caregivers n= 90 (%)	Government n=78 (%)	Patients n=93 (%)	Overall n=342 (%)
Yes	59.3	95.6	57.7	97.1	78.5
No	40.7	4.4	42.3	2.9	21.5
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 5.6 shows that in the past 12 months 37.6% (189) of respondents or their family members has used the A&E facility at a district hospital and 33.6% (169) at a primary healthcare facility. These findings are in line with the data obtained from the healthcare systems analysis in Chapter Three[40] and Gauteng Department of Health (2009).

Table 5.6: Type of A&E facility visited

Which type of A & E facility did you or a family member go to?	Consultants n=49 (%)	Caregivers n= 73 (%)	Government n=45 (%)	Patients n=84 (%)	Overall n=251(%)
Primary Healthcare Clinic	26.53	27.59	44.44	35.80	33.6
District Hospital	57.14	35.78	42.22	16.48	37.9
Provincial / Regional Hospital	10.20	17.24	8.89	35.80	18.0
Other	6.12	19.40	4.44	11.93	10.5
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

The question on the mode of travel to A&E facilities revealed that 47.9% (37) of the government officials used an ambulance and 30.1% (23) their own vehicle. In contrast, only 14.6% (14) of the patients used ambulances while 31.6% (29) used taxis.

[40] See section 3.11.

The questionnaire survey also investigated the effectiveness of the DGAEF in facilitating the development of accessible and responsive A&E facilities by asking the following questions: travel distance to the nearest A&E facility; average travel time and level of satisfaction.

Table 5.7 shows that 38.6% (125) of the respondents travelled between 11 km and 50 km to the nearest A&E facility. Consequently, depending on traffic conditions and the time of travel, 41.7% (135) of the respondents took between 30 minutes and one hour to arrive at the A&E facility. Of the caregivers, 49.8% (42) travelled between 6 km to 10 km to the A&E facility, with 59.9% (51) of them taking less than 30 minutes to reach it.

Table 5.7: Distance travelled to the nearest A&E facility

How far did you have to travel to get to an A&E facility?	Consultants n=79 (%)	Caregivers n= 85 (%)	Government n=73 (%)	Patients n= 87(%)	Overall n=324(%)
Less than 5 km	12.70	15.20	15.1	22.50	16.4
6 – 10 km	43.00	49.80	23.30	27.20	35.8
11 – 50 km	40.50	30.90	43.80	39.30	38.6
More than 50 km	3.80	4.1	17.80	11.00	9.2
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.0**

Table 5.7 also shows that the majority of patients, 39.3% (34), travelled between 11 and 50 km to reach the A&E facility. This is consistent with the discussion in Chapter Three on the organisation and structure of the healthcare system (see 3.8), and the consequences of the apartheid system of racially differentiated DGAEF resulting in under-provision of healthcare facilities within the areas where the black majority live.

The respondents were asked the following questions in order to explore their level of satisfaction on the following issues which are influenced by the DGAEF: proximity of the parking area to the main entrance; location of wayfinding signs; and welcomingness of entrance approaches to the A&E facility. Overall, 64.6% (209) of the respondents were satisfied with the location of the parking areas and wayfinding signs; and 66.6% (214) were satisfied with the design of the entrance areas.

Indeed, by observing the experiences and reactions of buildings users, the design team can acquire valuable insights and sensibilities to inform the spatial configuration of the buildings they design. These issues emerged in Malkin's (2008) and Rengel's (2007) studies, which argue that space configuration affects peoples experience and that an integrated physical setting can positively improve people's experiences.

5.3.2 Awareness, use of and compliance with the DGAEF

The respondents' views on levels of awareness, use and compliance with the DGAEF were gathered through their responses to the following questions: level of compliance with DGAEF and effectiveness of health services delivery in A&E facilities designed using the DGAEF; adequacy of space provision; project cost and effectiveness of use of resources. Finally, the respondents were asked their opinions regarding the efficiency and effectiveness of the project development process.

To investigate levels of awareness of the DGAEF, respondents were asked questions relevant to the issue, with responses in binary variables ("yes/no"). The majority, 63.5% (98), were aware of the DGAEF. The same question format was used to explore the level of use and compliance to the DGAEF amongst the consultants; and 83.3% (66) responded that they have not used them, while 48% (38) complied with the general and specific requirements. Table 5.8 shows that the level of compliance to the DGAEF among consultants and government officials was moderate.

Table 5.8: Level of compliance by the consultants and government

What is the level of the current compliance with the DGAEF amongst consultants and government?	Consultants n=79.00 (%)	Caregivers n= (%)	Government n=76.00 (%)	Patients n= (%)	Overall n= 155(%)
High	29.1	N/A	11.8	N/A	20.5
Moderate	24.1	N/A	47.4	N/A	35.5
Low	46.8	N/A	40.8	N/A	44.0
Total	**100.0**	**N/A**	**100.0**	**N/A**	**100.0**

Respondents views on the effectiveness of project development process of A&E facilities designed using the DGAEF were also sought; and the findings were that 41.2% (141) felt that it was adequate.

The Chi-Square test done for the level of awareness shows that there were significant statistical differences amongst groups (Pearson Chi-Square value is 50.949 and p-value is 0.000). However, the ANOVA test undertaken at the 5% significance level shows no significant statistical difference between consultants and government officials regarding their level of compliance to the DGAEF (the F ratio is 2.745 and p-value is 0.100).

The high level of awareness notwithstanding, the relatively low level of use and compliance amongst consultants may likely impact on the overall project development process. The above results are consistent with the assertion in Chapter Two that levels of awareness of the DGAEF may not necessarily influence levels of compliance (see 2.10.4).

The findings on adequacy of space provision were that 48.8% (39) of the consultants and 56.4% (44) of the government officials consider the DGAEF as lacking in the necessary information systems to facilitate improved A&E space design and provision. The findings regarding the project cost were based on the answers given by the consultants and government officials on the current average construction cost per square metre for A&E facilities using the DGAEF. Respectively 89.0% (72) and 91.0% (71) of the consultants and government officials do not know the current average construction cost per square metre.

The consultants and government officials were also asked their views on the effectiveness of use of resources for A&E facilities development. Table 5.9 shows that 95.5% (77) of the consultants and 85.3% (67) of the government officials were of the opinion that the resources allocation was ineffectively spent.

Table 5.9: Effectiveness of use of the budget allocation

Do you think that the budget allocation for A&E facilities are currently effectively spent?	Consultants n=81(%)	Caregivers n= (%)	Government n= 78(%)	Patients n= (%)	Overall n=159(%)
Yes	4.5	N/A	14.7	N/A	9.6
No	95.5	N/A	85.3	N/A	90.4
Total	**100.0**	**N/A**	**100.0**	**N/A**	**100.0**

The ANOVA test done at 5% significance level shows that there is no significant statistical difference between the consultants and the government officials with respect to their opinion on the effectiveness of use of the budget allocation for A&E facilities (the F ratio is 0.84 and the p-value is 0.772). This result means that they are in agreement that budget allocations are not effectively spent.

The respondents were asked to indicate the average timeframe for the construction of District, Regional and Tertiary (level 1, 2 and 3) facilities. Table 5.10 shows that 55.9% (45) of the consultants and 62.7% (49) of the government officials think that the timeframe for the construction of A&E facilities is excessive. To gain more knowledge on this issue, the respondents were asked whether the timeframe for A&E facilities project development process was appropriate in meeting the national need for A&E facilities. The findings are similar to those above—62.9% (51) and 77.3% (60) of the consultants and government officials respectively consider the timeframe for completion of A&E facilities incommensurate with national need.

Table 5.10: Construction time for level 1, 2, and 3 healthcare facilities

Adequacy of the construction time for L1, L2 &L3 A&E facilities?	Consultants n=81.00 (%)	Caregivers n= (%)	Government n= 78.00(%)	Patients n=(%)	Overall n=159(%)
Yes	44.1	N/A	37.3	N/A	40.2
No	55.9	N/A	62.7	N/A	59.8
Total	**100.0**	**N/A**	**100.0**	**N/A**	**100.0**

The ANOVA test conducted on construction timeframe for levels 1, 2 and 3 facilities shows no significant statistical differences between project development processes for these facilities. The F ratio is 0.001 and p-value is 0.973 for level 1 (District Hospital); the F ratio is 1.561 and p-value is 0.213 for level 2 (Regional Hospital); and the F ratio is 0.550 and p-value is 0.459 for level 3 (Tertiary Hospital). Thus, government emphasis on the development of L2 and L3 healthcare facilities notwithstanding, the timeframe for their project development process is still excessive. These results are consistent with the findings in Chapters Two and Three on construction timeframes for healthcare facilities (see 2.13.6 and 3.10).

5.3.3 DGAEF in relation to healthcare facility development goals

Insights on whether the DGAEF are achieving their main objective of improving the delivery of A&E facilities and providing a quality physical environment were also explored. Respondents were asked their views on the impact of the DGAEF on space provision, functional suitability, space utilisation and spatial relationships, as well as on interrelationships between DGAEF and A&E facility culture.

The respondents acknowledged the need to improve the space provision, design and spatial relationships of the key A&E facility zones. Table 5.11 shows that 38.49% (210) identified Zone B as being in need of urgent design guidelines update, while 23.60% (129) thought the same was needed for Zone C. These findings are in line with the literature review on the issue of the impact of the DGAEF on space provision, functional suitability, space utilisation and spatial relationships.[41]

Table 5.11: Impact of DGAEF on space provision, design, functions and spatial relationships

Please indicate in which of these A&E spaces you think the design guidelines need to be improved for more efficient use of space	**Consultants n=79(%)**	**Caregivers n=90(%)**	**Government n= 75(%)**	**Patients n=93(%)**	**Overall n=342(%)**
Entrance area (Zone A)	25.55	15.6	14.3	24.4	19.96
Examination area (Zone B)	43.25	44.3	35.1	31.3	38.49
Inpatient area (Zone C)	20.10	20.7	25.5	28.1	23.60
Support area (Zone D)	11.10	19.4	25.1	16.2	17.95
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

[41] See Chapter Two: 2.11.2; and Chapter Three: 3.12.

To explore the interrelationships between DGAEF and institutional transformation, the respondents were asked their opinions on levels of patient comfort in facilities designed using the DGAEF, based on factors such as noise level, positive distractions, patient/family comfort (lighting, temperature, auditory/visual privacy/TV) and family support spaces (overnight bed, comfortable waiting areas and private areas). Table 5.12 shows that 55.2% (45) of the consultants think that the DGs allow for adequate patient comfort in A&E facilities compared with 26.7% (21) of government officials.

Table 5.12: DGAEF and A&E facility culture

Patient Comfort					
Do the design guidelines allow for adequate patient comfort in A&E facilities?	**Consultants n=81(%)**	**Caregivers n=90(%)**	**Government n= 78 (%)**	**Patients n=93 (%)**	**Overall n=342 (%)**
Adequate	55.2	40.1	26.70	39.39	40.35
Undecided	32.1	41.5	39.82	28.48	35.47
Inadequate	12.7	18.4	33.48	32.13	24.18
Total	100.0	**100.0**	**100.0**	**100.0**	**100.0**

The Chi-Square test shows a statistically significant difference between the respondents groups (Pearson Chi-Square value 215.744 and p-value 0.000). These results suggest that improved patient comfort outcomes can positively influence users' perceptions and the quality of their experience of healthcare facilities. This view is line with the Planetree philosophy elaborated in Chapter Two (see 2.7).

5.3.4 The influence of the DGAEF on technology innovation and update

The influence of the DGAEF on design innovation was explored by asking the respondents their views on the role of DGs in technology innovation and update. Of the 315 respondents from all groups, 55.46% (175) consider it necessary to introduce DQIs in the DGAEF for evaluation of the level of technology innovation and update. Respondents were also asked their opinion on the use of technology for determining space programming, space design and provision, functional suitability and spatial arrangements. The introduction of adaptable and flexible general and specific design requirements for A&E facility spaces in the DGAEF update is favoured by 50.23% (157) of all respondents.

5.3.5 Standardisation of the project development process and life-cycle costs

In the literature, it is argued that standardisation of the project development process and the introduction of life-cycle costs can help address constraints to the development of improved A&E facilities, in particular with respect to quality of the finished product, time and cost. The respondents' views on this are summarised in Table 5.13.

Table 5.13: Introduction of standard project development protocols

Are you in favour of the introduction of standard project development tools for A&E facilities with provision for minor changes?	Consultants n=80(%)	Caregivers n=90(%)	Government n= 78(%)	Patients n=(%)	Overall n=168(%)
Yes	2.5	97.7	11.9	N/A	37.37
No	97.5	2.3	88.1	N/A	62.63
Total	**100.0**	**100.0**	**100.0**	**N/A**	**100.0**

Table 5.13 shows that 97.7% (88) of the caregivers favour the introduction of standard project development tools in the DGAEF update; in contrast, 97.5% (78) of the consultants and 88.1% (69) government officials are not in favour of their use. As regards the need to introduce benchmarking tools in the DGAEF for evaluating life-cycle costs of the project, 78.5% (63) and 86.3% (67) of the consultants and government officials respectively were in favour of their use during project development processes.

The Chi-Square test shows statistically significant differences in the opinions of the respondents on the introduction of standard project development tools for A&E facilities (Pearson Chi-Square value is 35.041 and p-value is 0.000). The same test conducted on the responses on the need for benchmarking tools for evaluating life-cycle costs during project implementation phases similarly shows significant statistical difference in the respondents' opinions (Pearson Chi-Square value is 22.471 and p-value is 0.000). This implies that despite the unpredictability of the timeframe, and quality and cost of the finished product, the consultants and government officials still do not favour the use of standardised systems as they argue it may likely influence the outcome of the project development process, in particular design solutions. These findings are in line with those in the literature review on standardisation of project development processes (see 2.10.5).

5.4 Respondents comments on DGAEF update based on Planetree principles

The fundamental principles of the Planetree philosophy are based on incorporating the natural, built, social and symbolic environments in the space design and provision of healthcare facilities. It is argued in the literature that using the Planetree philosophy for DGs development emphasizes personalisation and humanisation of the healthcare environment to improve positive outcomes in the quality of healthcare services delivery; and also results in best value for patients, caregivers and healthcare institutions.

Thus, the respondents' views on the following issues and gaps identified in the DGAEF which would inform the guiding principles for the DGAEF update based on Planetree principles (see 2.7) were also solicited:

- improving community interaction in A&E facilities through DGAEF;
- the importance of broad based participation in DGAEF update;
- the impact of DGAEF on the quality of the physical environment and services delivery;
- the influence of DGAEF on innovative A&E facility design and operational systems; and
- use of research-based DGAEF to improve the design and implementation process.

5.4.1 Improving community interaction in the A&E facility through DGAEF

To explore the role of DGAEF in provision of spaces for interaction of users of A&E facilities, the respondents were asked to indicate which spaces they would like to see modified or newly introduced.

Figure 5.1 shows that 47.81% (43) of patients would like larger examination rooms to allow visitors within these spaces; and likewise favour the introduction of private patient/family waiting areas. Furthermore, 35.57% (32) favour the introduction of DGs for children's entertainment areas; and one in two would also like to see separate staff/patient corridors. The consultants, caregivers and government officials favour the provision of general and specific design requirements in the DGAEF for a resource centre/library.

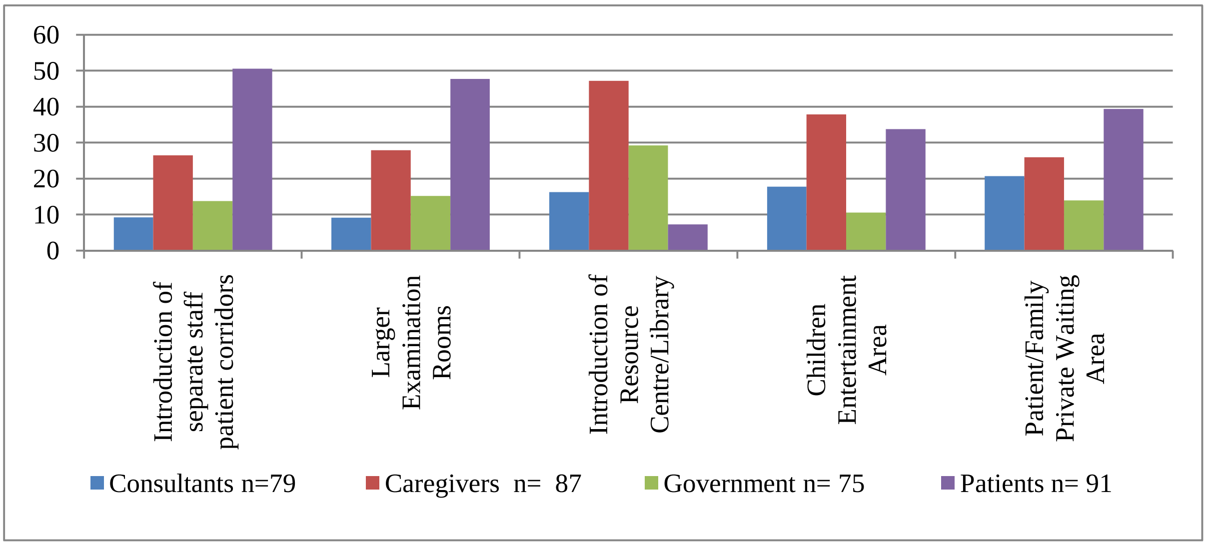


Figure 5.1: Provision of social spaces for interaction

A Chi-Square test was undertaken at 5% significant level to determine if there was significant statistical differences in the respondents views regarding where they would prefer the introduction of social spaces for interaction between and amongst staff/patients/visitors. The results show statistically significant differences in the views of the respondents: for staff/public corridors (Pearson Chi-Square is value 14.63 and p-value is 0.00); for larger examination rooms (Pearson Chi-Square value is 77.97 and p-value is 0.00); for resource centre/library (Pearson Chi-Square value is 10.68 and p-value is 0.01); for children's entertainment area (Pearson Chi-Square value is 17.51 and p-value is 0.00); and for patient/family/visitors waiting area (Pearson Chi-Square value is 108.68 and p-value is 0.00). These results highlight the differences in the preferences of the different user groups with regard to the social spaces that they would like to provided.

5.4.2 The importance of broad based participation in DGAEF update

A participatory approach that involves all stakeholders is difficult to organise for any community issue, including DGAEF (The Center for Health Design, 2009). However, the literature review reveals that there are major benefits in seeking the opinion of all relevant stakeholders in the DGAEF update process.[42] Respondents were thus asked their views on whether general and specific requirements should be introduced in the DGAEF to influence broad based participation in A&E facility development. Their views on the statutory bodies, private firms and individuals that should participate in the DGAEF update were also solicited.

The results show that 87.2% (319) of the respondents were of the view that participatory processes should be introduced in the DGAEF. Figure 5.2 shows that the caregivers group recommended the following stakeholders participate in the DGAEF: Department of Health/Works/Finance, consultants, academics, caregivers and the community. The patient group favoured the participation of the same stakeholders, albeit with lower percentages. The consultants and government groups recommended most of the same stakeholders mentioned by the caregivers category, but also included Department of Social Workers and Education. Specifically, 25.0% (38) of consultants and 23.03% (35) of government officials recommended including Department of Social Workers; and 26.85% (29) of consultants and 30.56% (33) of government officials were in favour of including Department of Education. In addition, 17.55% (33) of consultants and 21.28% (40) of government officials were also in favour of consulting patients during DGAEF.

5.4.3 The impact of DGAEF on quality of the physical environment and healthcare services delivery

A growing number of studies have established the important relationship between the physical environment and healthcare services delivery.[43] The impact of DGAEF on the quality

[42] See Chapter Two: 2.10.3.

[43] See, for example, Ulrich et al. (2008).

of the physical environment and services delivery was thus investigated by asking respondents their views on the quality of the interior architecture and services delivery; on the effectiveness and efficiency of the internal layout; and on the contribution of DGAEF to staff/patient/visitors needs.

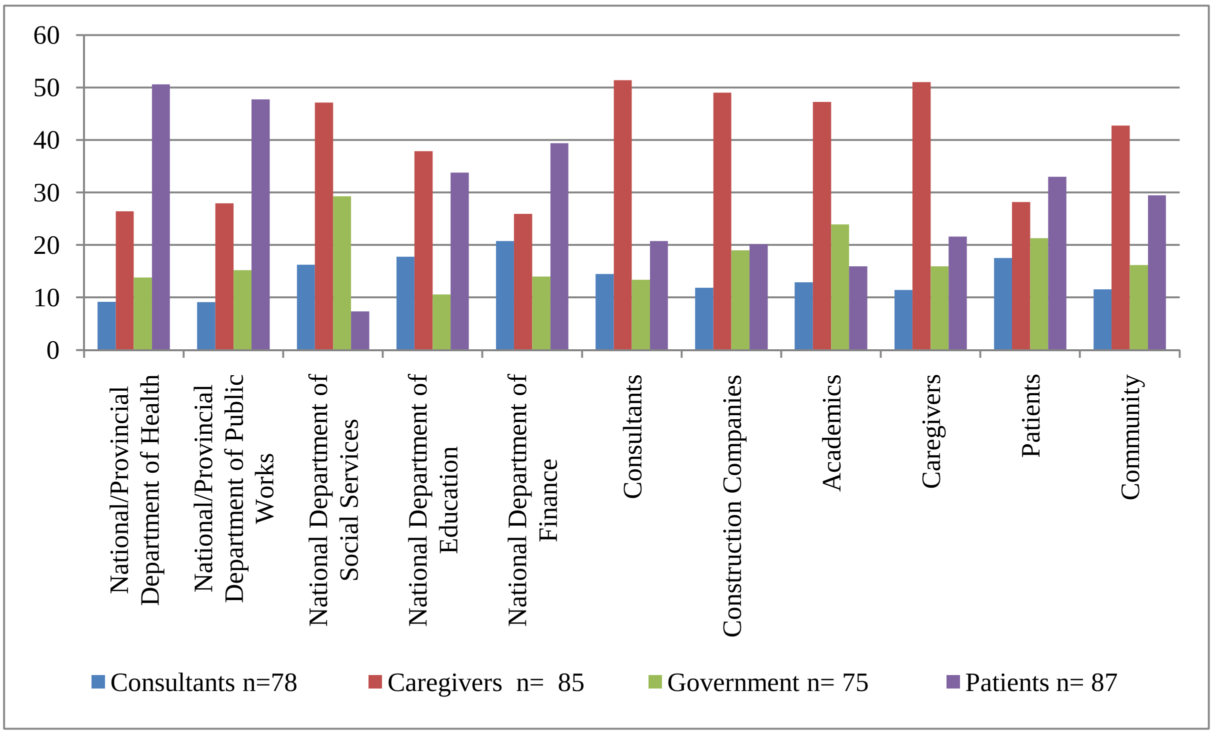


Figure 5.2: Key stakeholders to participate in DGAEF update

Figure 5.3 shows that 57.5% (311) of the respondents think the floor plan layout and interior architecture do not meet users' needs. This finding is in line with the interviews results, which suggest that the DGAEF limit staff/patient/visitors choice, control and comfort (see 6.4.3).

The respondents consequently identified areas in the A&E facilities at CHBH and PAH that the DGAEF can help improve. The caregiver's category thought that a more efficient and effective floor plan configuration can address the following issues: easy access to temperature and light control; access to technology; improved social interaction; easy surveillance of patients/visitors and location of supplies/equipment in operational zones to reduce walking distances. The consultants, government officials and patients groups gave similar responses, with respectively 26.29% (58), 30.27% (23) and 29.73% (48) of the view that equipment noise reduction can be achieved by improving the floor plan.

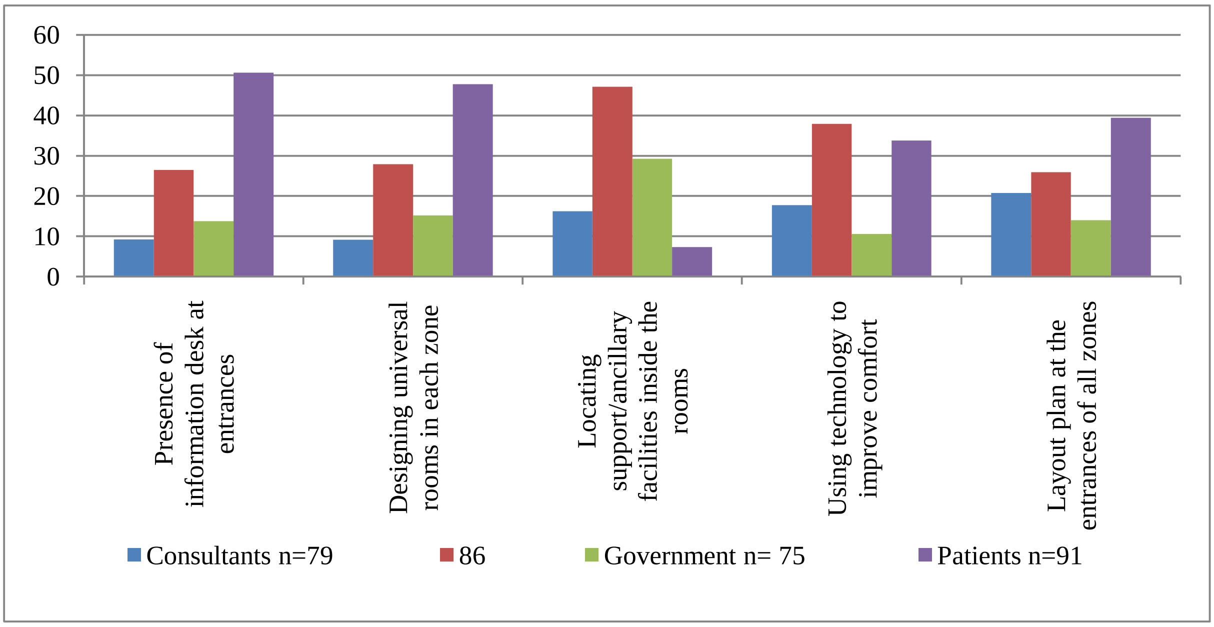


Figure 5.3: Improved floor plan layout and accessibility

5.4.4 The influence of DGAEF on innovative A&E facility design and operational processes

New design or renovation work can provide a unique opportunity for healthcare institutions to transform their approach to facility design, operational parameters and procedures, and culture. In this regard, DGAEF can provide detailed information on operational and space requirements at the design-front end. As Hayward (2006a) affirms, this process, if followed, can encourage the design team and healthcare organisation to rethink their operational and facility design approach.

Respondents were asked their views on the provision of only private rooms and speciality departments in the A&E facilities, and whether DGs limit design innovation. The results show that 53.9% (50) of patients favoured the introduction of general and specific design requirements for universal patient rooms; but the overwhelming majority 75% (68) of caregivers opposed the introduction of the universal room concept. The consultants group agreed with the caregivers on this issue, with 59.3% (48) against the introduction of universal patient rooms. The government officials favoured introducing adaptable acuity rooms.

As regards the introduction of speciality departments in A&E facilities, the caregivers were in favour of introducing DGs for the following units: obstetrics and gynaecology, paediatrics, psychiatrics, chest pain, occupational therapy, poison control and burns facility. The patients category's preferences with respect to introduction of speciality departments were similar to those of the caregivers group, with exception of the psychiatric unit. The consultant and government groups favoured introduction of the same speciality units as the caregiver and patient groups, but gave preference to psychiatric and poison control units.

Figure 5.4 shows that, overall, the preferred speciality units were: obstetrics and gynaecology—50.57% (47) of patients; psychiatrics—47.15% (42) of caregivers; chest pain—37.88% (34) of caregivers; poison control—30.95% (29) of patients; and burns facility—37.80% (35) of patients. These findings are in line with the literature on new trends in design and space provision in health care facilities.[44]

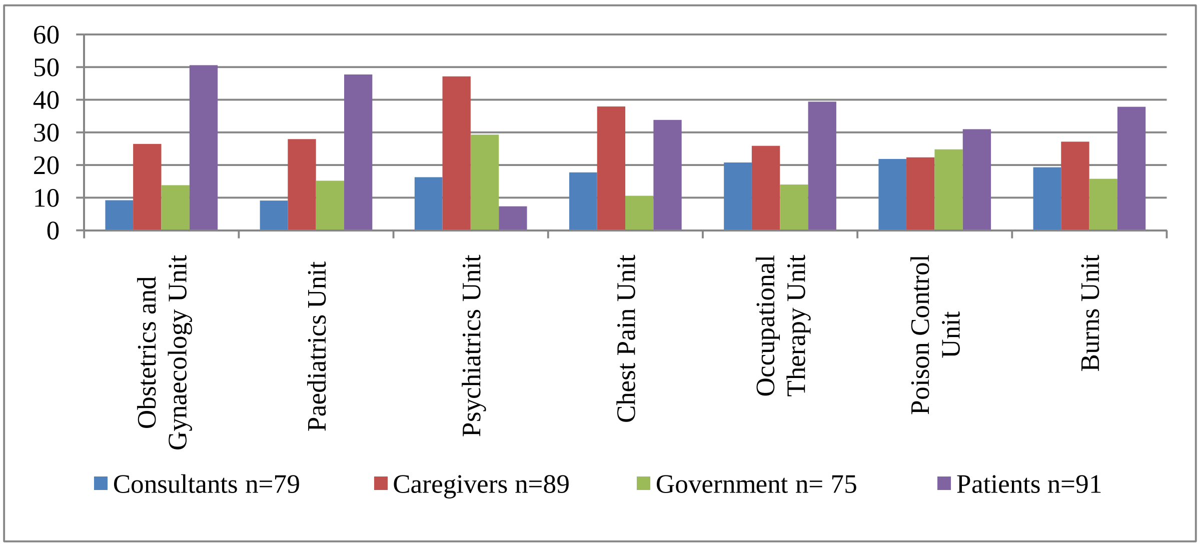


Figure 5.4: Introduction of speciality departments in A&E facility

[44] See sections 3.12.

Table 5.14 shows that the consultants and government officials were of the view that DGs can assist design teams improve space design and provision in A&E facilities projects, with 82.4% of respondents in these two groups affirming the same. This finding agrees with the findings in literature on the introduction of innovative design tools to address the issues relating to current project development processes (see 2.3 and 2.11).

The Chi-Square test at significance level of 5% showed that the observed Pearson Chi-Square value was 7.045 and p-value was 0.007, which suggests statistically significant differences in the opinions of the consultants and government officials.

Table 5.14: DGAEF and innovation

Can introduction of DQIs in the DGAEF update assist the design team in improving space design and provision of A&E facilities?	**Consultants n=78 (%)**	**Caregivers**	**Government n=76 (%)**	**Patients**	**Overall n= 151 (%)**
Yes	9.0	N/A	26.3	N/A	17.7
No	91.0	N/A	73.7	N/A	82.4
Total Percentage	**100.0**	**N/A**	**100.0**	**N/A**	**100.0**

According to Hamilton (2009), DGAEF used in a certain context may not necessarily produce the same result when used in another setting. Therefore, innovative DGAEF can provide general and specific design requirements that can be adapted to clients’ needs and contextual issues.

5.4.5 Using DGAEF developed through research to improve design tools

The findings on the influence of DGAEF on innovative A&E facility design and operational system recommend using research to develop design performance indicators in the design tools. This corresponds with Hignett and Lu’s (2008a) findings on the need to update the DG used in UK for healthcare facilities through research. This study argues that lack of performance indicators in the general and specific design requirements in the DGAEF limits compliance by the design team, at the expense of increased consumerism resulting in inequitable provision of A&E facilities. In addition, there is less emphasis on DQIs for evaluating space design/provision; space functionality/utilisation and spatial relationships in order to create awareness and encourage compliance to the use of DGAEF.

Several studies in the literature confirm that space design and provision influence the following issues related to the perceived quality of services delivery in a healthcare facility: capacity efficiency; patient comfort/safety/privacy; and family amenities.[45] Capacity efficiency performance indicators are influenced by circulation and access to data, supplies, around patients, and in/out of rooms. The literature also affirms that patient comfort, safety and privacy are influenced by visibility in/out of the corridor; visual and auditory privacy; views to the exterior; access to natural light and views; provision/location of hand-washing sinks; and availability of appropriate storage facilities.[46] Furthermore, the literature supports the argument that family/visitors' positive perception of the facility are influenced by proximity to the patient; access to television/internet; provision of convenient overnight accommodation and space for social interaction (in particular with caregivers and patients).

Improving the spatial configuration can potentially influence caregivers' work environment, increase daily throughput, improve overall satisfaction, mitigate stress levels, promote staff retention and enhance patient satisfaction (Hendrich, 2003a). Respondents were, therefore, asked to indicate the measures that needed to be introduced in the DGAEF to improve compliance and whether reviewing appointment procedures for the consultants would influence compliance amongst the stakeholders.

Figure 5.5 shows that 70.77% (46) of consultants indicated that a good design brief would improve compliance, while 62.75% (32) of consultants favoured the introduction of simpler design guidelines. Flexible/adaptable design guidelines had the highest score among the consultants—72.22% (39).

Figure 5.5 also shows that 39.13% (31) of government officials indicated that performance standards could encourage compliance, while 37.25% (29) favoured the

[45] See Chapter Two (2.9.2)

[46] See also Chapter Two (2.6.7 and 2.12.6)

introduction of simpler design guidelines. The introduction of a good design brief was supported by only 29.23% (19) of government officials ranking it fourth among this category.

The consultants' recommendation with regard to the introduction of a good design brief or user friendly DGs agrees with the findings of the Hayward (2006b) on the need to introduce simpler and more generic design guidance based on comparative research. The government officials support the introduction of performance standards in the DGAEF, which they believe may improve the current level of compliance by stakeholders. This standpoint is consistent with Hamilton's (2009) argument that DGs can focus on providing performance standards that detail evaluation criteria to be used by the design team for space design and provision, functional suitability/space utilisation and spatial relationships.

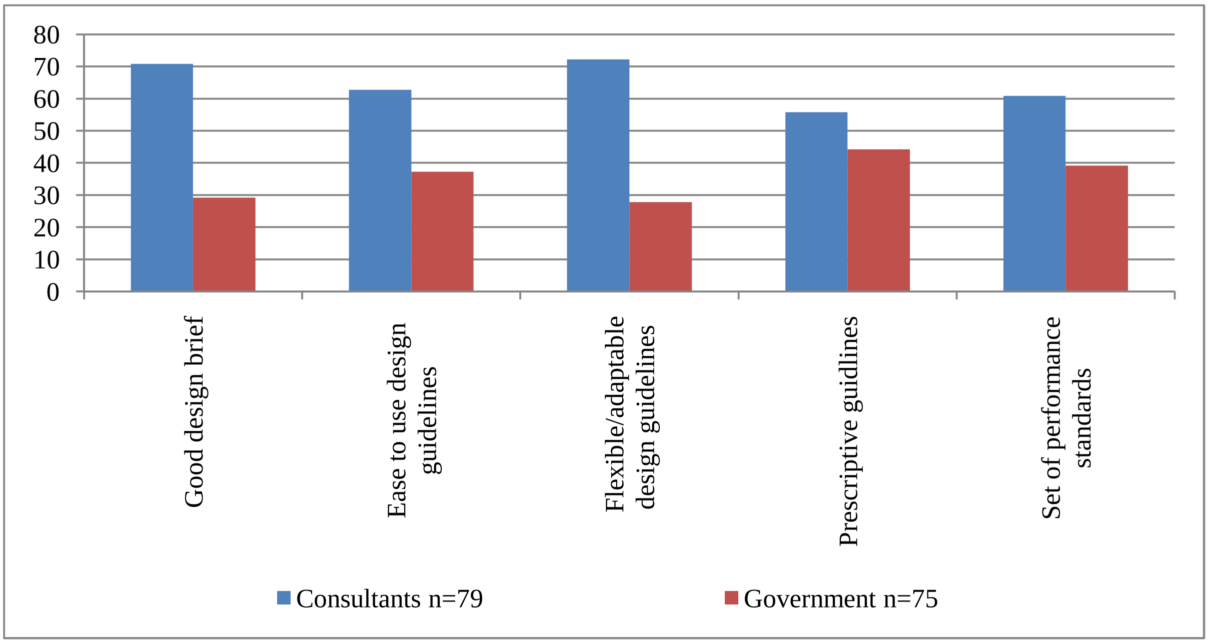


Figure 5.5: Measures in the DGAEF to encourage compliance

The views of the respondents regarding the role the appointment procedure for consultants would play in influencing compliance are presented in Table 5.15. The results reveal that 85.33% (64) of consultants indicated that adopting a new procurement system may not necessarily improve the current situation. In contrast, 65.79% (50) of the government officials were of the view that a new procurement system can encourage and probably improve the current level of compliance among stakeholders. The government officials blamed the existing procurement policy for professional services in South Africa for the low level of compliance to DGAEF by stakeholders (see 6.3.3).

The Chi-square analysis revealed significant statistical differences between the consultants and government officials in their views regarding the introduction of a competitive procurement policy for the award of healthcare design projects. The result of the Pearson Chi-Square value was 40.974 and p-value was 0.000. The views of the government officials agree with Barlow's (2008) argument that to stimulate innovation in infrastructure development, government procurement models have to be effectively updated.

Table 5.15: Procurement Policy for Professional Services

Can appointment of consultants through design competitions influence compliance to DGs?	Consultants n=75 (%)	Caregivers n= (%)	Government n= 76 (%)	Patients n= (%)	Overall n= 151 (%)
Yes	14.67	N/A	65.79	N/A	40.2
No	85.33	N/A	34.21	N/A	59.8
Total Percentage	**100.0**	**N/A**	**100.0**	**N/A**	**100.0**

5.5 General opinions on the obstacles to the use of DGAEF

To gain knowledge on the above issues, the respondents were asked to indicate their views on the major obstacles limiting compliance to DGAEF, which were identified based on evidence from the literature and knowledge gained by the researcher working in this field for the past 11 years. However, the choices given to the respondents were open-ended; therefore, additional obstacles obtained from their responses were also introduced to the list.

The respondents' answers were compared and analysed using a five-point ranking scale according to the following levels of influence: very low; low; moderate; high and very high. For purposes of analysis, the five-point ranking scale was collapsed into a three-point ranking scale as follows: "very low" and "low" were grouped as "low"; "high" and "very high" were grouped as "high"; and moderate remained unchanged. SPSS software was used to generate frequency distributions, and an ANOVA test at 5% significance level was undertaken where appropriate to analyse the opinions of the stakeholders.

5.5.1 Obstacles identified by the consultants limiting compliance to DGAEF

The respondents were asked to rank the 10 identified obstacles to compliance to DGAEF (see Appendix C). The responses obtained were ordered according to their relative impact on the development of A&E facilities using the three-point ranking scale—low; moderate and high. Figure 5.6 illustrates the four major obstacles identified by the consultants ranked in order of their influence on.

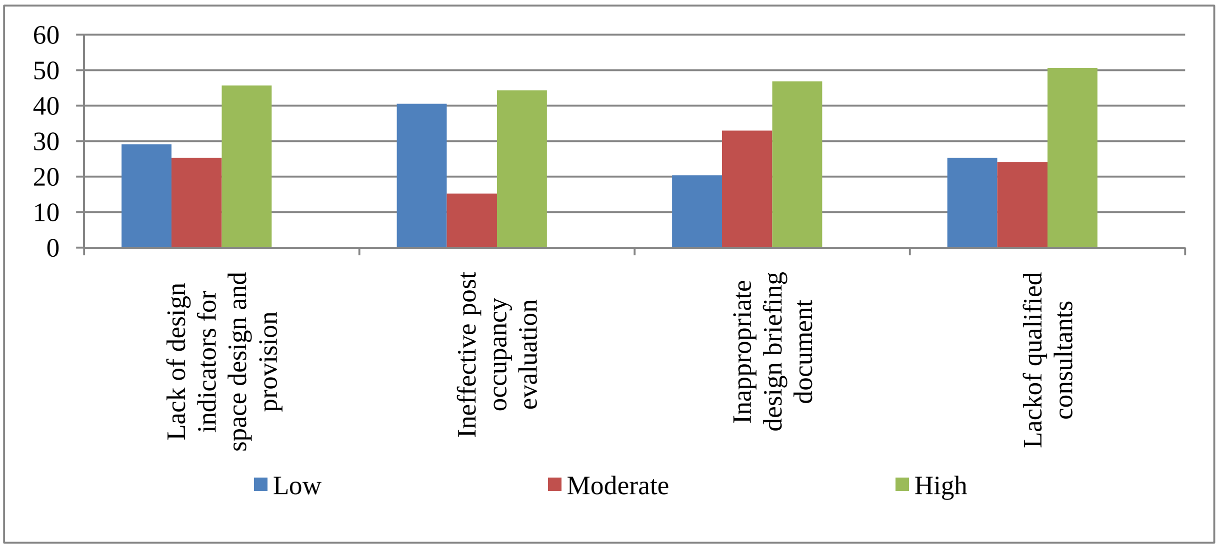


Figure 5.6: Obstacles identified by the consultants limiting compliance to DGAEF

Figure 5.6 reveals that 53.6% (40) of consultants considered the lack of indicators for space design and provision, functional suitability and spatial relationships to be the major obstacles to compliance to DGAEF. An ineffective POE system was ranked second by 50.6% (38) of consultants; an inappropriate design briefing document third—46.8% (37); and lack of qualified consultants fourth—41.8% (33). The major obstacles to compliance listed by the consultants relate to the thematic categories identified from the literature, namely design tools, quality of the physical environment and perception (see 2.15).

5.5.2 Issues identified by Government staff as obstacles to compliance to DGAEF

Figure 5.7 shows the four major issues identified by the government officials, ranked according to their influence on compliance to DGAEF. The need for an effective POE system was identified by 46.1% (35) of government officials; and 44.7% (34) cited the need for demonstration projects to improve compliance to DGAEF. The need to improve project implementation systems was identified by 43.4% (33) of respondents from this group; and the inappropriateness of the design briefing document by 40.8% (31).

It was noted that the other issues cited do not directly relate to the themes identified in the literature—design tools; quality of the physical environment and perception—and were ranked by below 40.0% of the government staff. The major issues identified by the government staff were consistent with the consultants' views (see Figure 5.6 and Figure 5.7). The literature review also identified the same issues as major factors limiting compliance.

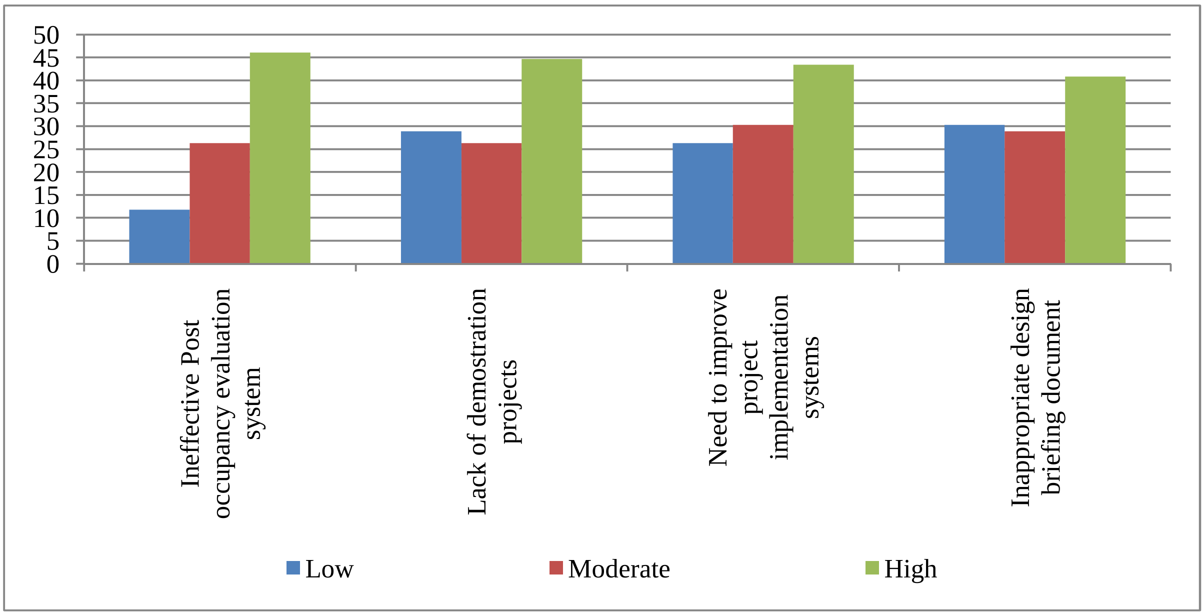


Figure 5.7: Issues identified by Government staff as obstacles to compliance to DGAEF

5.5.3 Issues identified by the caregivers as obstacles to compliance to DGAEF

Figure 5.8 shows that 76.1% (169) of caregivers were of the opinion that poor workload prediction is a major factor influencing space design and provision, functional suitability and spatial relationships. As Figure 5.8 shows, ineffective POE systems and attitude and behaviour of the stakeholders were respectively cited by 73.5% (161) and 63.6% (140) of caregivers. This issue was seen by this respondent group to significantly influence compliance.

The fourth major obstacle identified constraining caregivers' operations in A&E facilities was the need to design integrated spaces for multiple uses which received 62.3% (56) of caregivers.

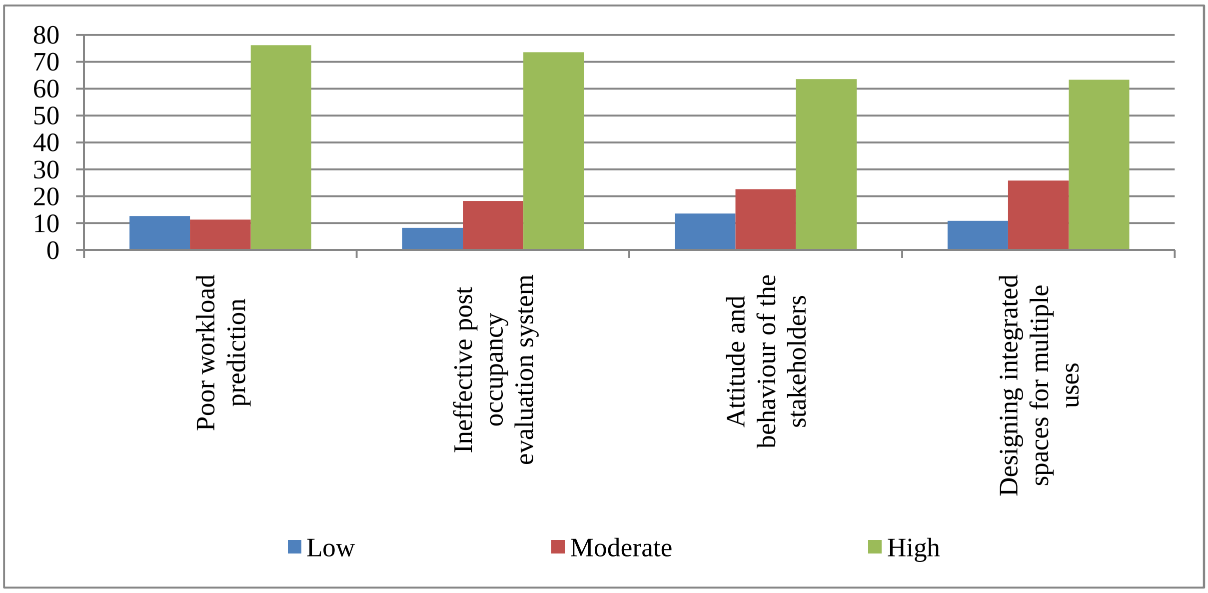


Figure 5.8: DGAEF-related obstacles identified by caregivers limiting their operations

An ANOVA test was performed at 5% significance level to identify whether there were any significant statistical differences between the consultants and government staff's opinions regarding the obstacles limiting compliance to DGAEF. The results obtained on the need for an appropriate design briefing document showed that there were significant statistical differences (F ratio is 19.060 and p-value is 0.000). A similar analysis was conducted on the opinions of the consultants and caregivers regarding the need for effective (F ratio is 16.513 and p-value is 0.000). Therefore, it seems reasonable to conclude that the obstacles identified by the stakeholders can be addressed by developing and introducing DQIs for evaluating: space design and provision; functional suitability and spatial relationships in DGAEF update.

In line with the findings on the obstacles limiting compliance to DGAEF, the major factor impacting directly on caregivers' operations in A&E facilities was lack of effective tools for conducting POE. The literature on healthcare facility design supports the issues identified by the caregivers constraining A&E operation. The findings also agree with the thematic categories identified from the literature review—design tools; the quality of the physical environment and perception (see 2.14).

5.6 Perceptions on factors affecting compliance to the DGAEF

Perceptions on factors affecting compliance to the DGAEF were explored through the respondents' ranked answers based on the three-point ranking scale explained in section 5.5, on the following statements/issues: update of the DGAEF is long overdue; poor research culture in this field; inappropriate project briefing tools; standardisation of design and project development process; assigning of implementation of A&E facilities projects to one institution; and protracted project development programme.

Respondents' perceptions on the following issues were also solicited and ranked: need for introduction of social spaces to encourage interaction amongst users; need for sustainable DGs; and need to develop and introduce in the DGAEF design indicators for space design and provision; functional suitability and spatial relationships.

As above, the respondents' answers were compared and analysed using a five-point ranking scale as follows: strongly disagree; disagree; undecided; agree and strongly agree. This was subsequently collapsed into a three-point ranking scale as follows: "strongly disagree" and "disagree" were grouped as "disagree"; "agree" and "strongly agree" were grouped as "agree"; and undecided was not changed.

5.6.1 Consultants' perceptions on factors affecting compliance to the DGAEF

Figure 5.9 graphically presents the four statements that received the highest scores from the consultants' responses. It shows that 53.8% (43/80) of the consultants agreed that update of the DGAEF is long overdue, and 50.0% (40) agreed that there is a poor research culture in healthcare facilities projects. The third ranked statement—the need for design indicators for evaluating space design and provision—was supported by 43.8% (35) of the consultants. Their perception on the statement relating to the need for sustainable design solutions ranked fourth—42.5% (34). This result is consistent with Shepley et al.'s (2009) assertion that the concept of sustainability is currently shaping debates, designs and developments in healthcare architecture.

Another important issue that emerged from the perception of the consultants, but which is not shown in Figure 5.9 as it ranked fifth (50.2% (40) consultants), is the need to assign development of healthcare projects to one institution to improve compliance to DGAEF. This result is in line with the PFI approach currently used extensively in UK.[47]

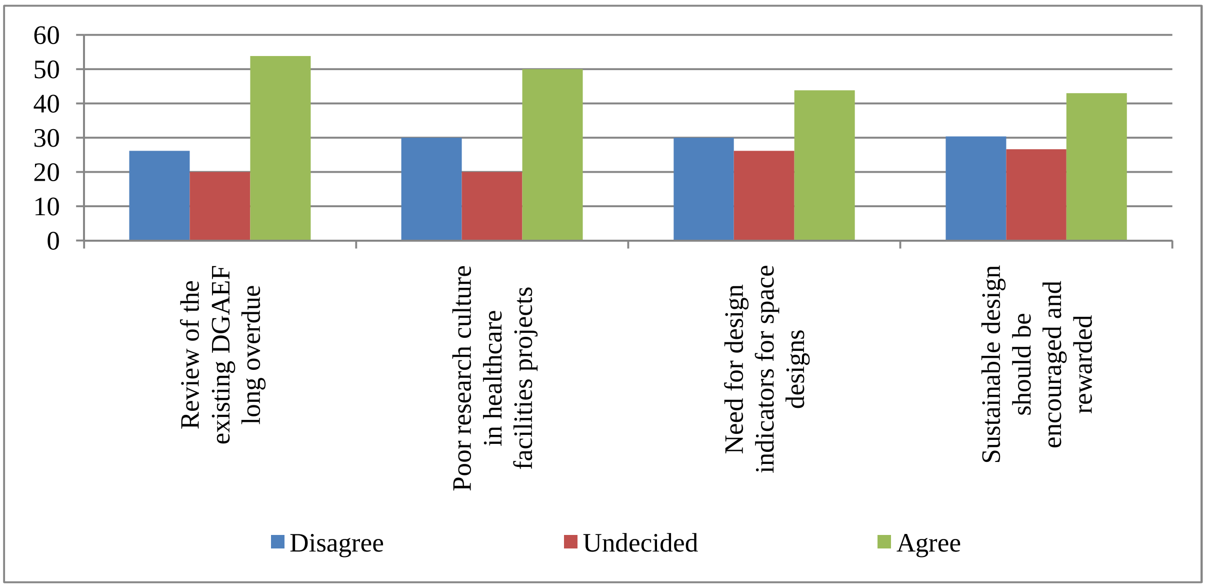


Figure 5.9: Consultants perceptions on compliance to DGAEF

[47] See 2.11.2 and 2.12.

From the above results it is clear that the four top ranked statements by the consultants support the findings in section 5.5, and also relate to the thematic categories identified in the literature review (see 2.14).

5.6.2 Government officials' perception on factors affecting compliance to the DGAEF

Figure 5.10 shows that 63.2% (48/76) government officials agree that the Provincial Department of Health in South Africa lacks good design briefing documents; 56.6% (43/76) agree on the need to standardise the project development process; and 52.6% (40/76) on the need to introduce general and specific requirements in the DGAEF to ensure environmentally responsible project development processes for A&E facilities . The latter reflects the findings in section 5.6.1 and the literature review (see 2.13.2).

The need for using comparative data obtained from research was ranked fourth, 50.5% (38/76) of government officials supporting the view that it is important to use a research approach for developing information systems for DQIs for space design and provision; space functional suitability and spatial relationships. The findings discussed here agree with the results obtained in section 5.6.1 and in the literature review (see 2.11.1).

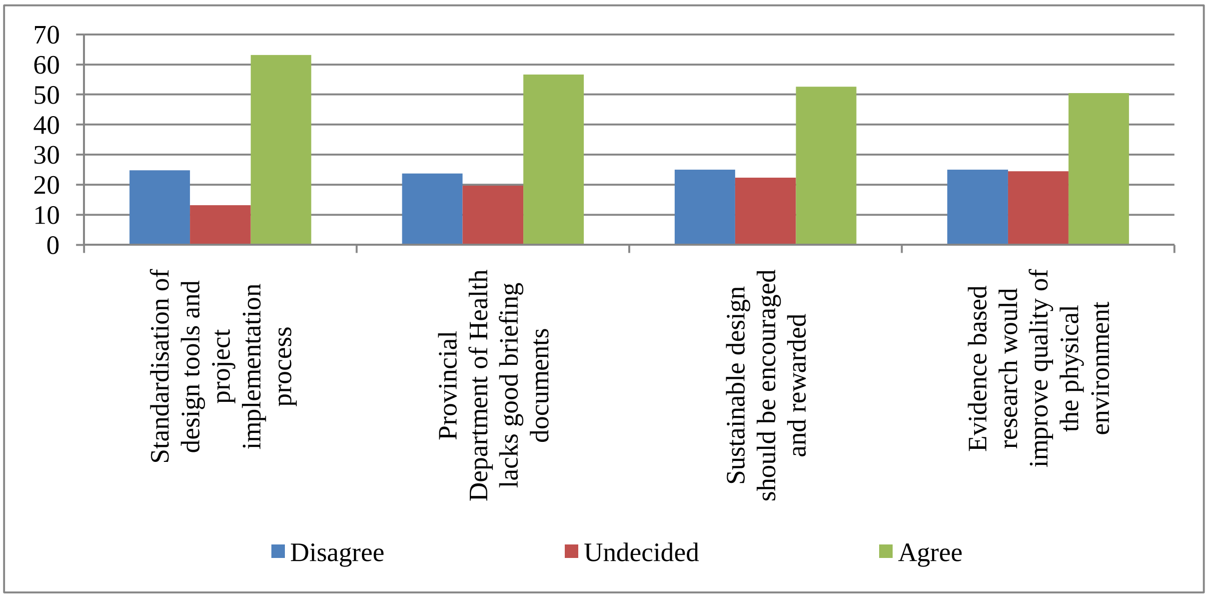


Figure 5.10: Government official's perceptions on compliance to DGAEF

Government officials' perceptions on the 10 statements regarding compliance to DGAEF varied between agree and disagree. The findings from this study are an important indicator of the level of satisfaction of stakeholders involved in the use of the DGAEF. Moreover, the perceptions of the government officials reflect the real situation in this field. Indeed, the four top ranked statements by the government officials are consistent with the thematic categories identified in the interviews and the literature (see 2.14).

5.6.3 Caregiver's perception on factors affecting compliance to the DGAEF

As indicated in Chapter Three (see 3.10), the perception of caregivers and their daily operational experiences in A&E facilities can be an important indicator for the evaluation of the degree of satisfaction with respect to the DGAEF used for their development and the quality of the physical environment. Therefore, caregivers' perceptions concerning the 10 factors affecting compliance to the DGAEF were investigated (see Appendix D). As explained in section 5.6.1, the results from the data analysis were rank-ordered using a three-point scale—disagree; undecided and agree. Figure 5.11 shows the results of the four top ranked factors affecting compliance to the DGAEF according to the caregivers' perceptions.

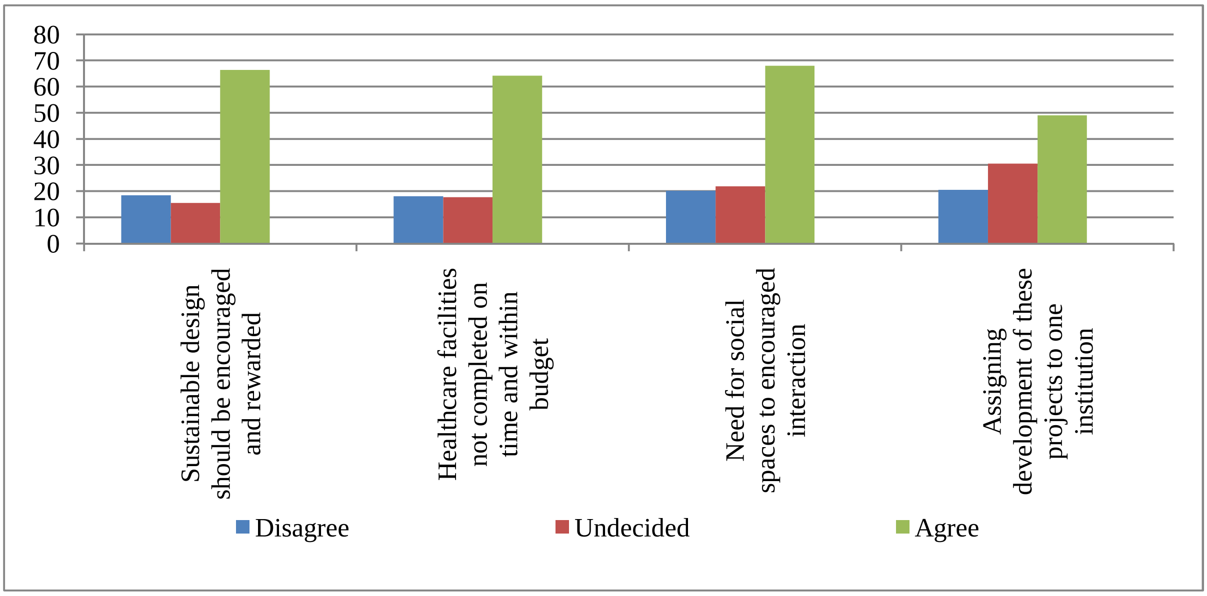


Figure 5.11: Caregivers' perceptions on compliance to DGAEF

As Figure 5.11 shows, 66.4% (57/86) of caregivers agreed that sustainable design should be encouraged and rewarded. This finding concurs with the results obtained and discussed in 5.6.1 and 5.6.2. Unpredictable project development programme and cost was ranked second, with 66.2% (57/86) of caregivers perceiving it to influence compliance to the DGAEF. The majority of respondents from the other groups agreed with this statement (see Appendix R: analysis of questionnaires survey).

The statement concerning the need for the introduction of social spaces to encourage interaction amongst the users of the facility received the third highest score, 64.6% (56/86) of caregivers. The findings from this investigation agree with the result in section 5.4.1.

Assigning development of healthcare projects to one institution in order to improve compliance to DGAEF was supported by 42.5% (37/86) of caregivers. This finding agrees with that of the consultants in section 5.6.1 above.

The caregivers' perceptions on the 10 factors affecting compliance to the DGAEF also varied between disagree and agree, and were consistent with most of the statements relating to the obstacles limiting compliance to DGAEF. Furthermore, the four top ranked statements by the caregivers related to the thematic categories identified in Chapter Five and discussed in the literature review—design tools; quality of the physical environment; and perception.

An ANOVA test was performed at 5% significance level to determine whether there were significant statistical differences between the responses of the consultants, government officials and caregivers on the statements regarding compliance to the DGAEF. The results on the need for evidence-based research to improve the design tools for design and construction of A&E facilities showed that there were significant statistical differences (F ratio is 17.835; p-value is 0.000). The same analysis undertaken on the need to develop general and specific design requirements for a sustainable design and construction approach obtained the following results: F ratio is 25.886; p-value is 0.000.

The same analysis undertaken on the rest of the statements regarding compliance to the DGAEF showed that there were significant statistical differences between the responses given by consultants, government officials and caregivers. However, the ANOVA test at 5% significance level done on "assigning development of healthcare facilities project to one institution" and on "standardisation of design tools and project implementation process" did not show any significant statistical difference in the perceptions of the respondents. These differences can be attributed to the differences in the profiles of the key actors, their backgrounds and their respective work environments.

5.7 Summary and conclusion

The empirical findings in this chapter have provided insights about the profiles of the key stakeholders and their views on the DGAEF. Their views on awareness, use and compliance with the DGAEF, as well as on their impact on healthcare policy and healthcare system goals, have also been explored. In addition, the influence of the DGAEF on design innovation, standardisation and the use of technology for construction of A&E facilities have been investigated; and methods for project briefing and design evaluation criteria, aimed at encouraging an all inclusive design approach through DGAEF discussed.

An important issue identified is the need to develop and introduce indicators in the DGAEF for evaluating the quality of the internal and external physical environment to improve A&E facilities. Furthermore, information on the importance of DGAEF on innovative A&E facility design and operational systems was also obtained. Knowledge was gained on the need to research and develop design performance indicators for the project development process. Finally, the respondents provided opinions and perceptions about barriers to the use of and compliance with the DGAEF. Table 5.16 summarises the findings on the respondents' views on the issues constraining the use and compliance to the DGAEF.

The findings point to recommendations on how to address the issues that have emerged regarding the DGAEF and a new approach to their update. The findings also provide evidence that will go towards filling identified gaps in the current knowledge on DGAEF.

Table 5.16: Opinions of the respondents' on obstacles limiting compliance, environmental issues and categories of themes that can influence the update of DGAEF

Identified problems	Environmental design issues	DGAEF themes
Lack of design indicators for space design and provision, functional suitability and spatial relationships	Improved functional, spatial relationships and operational spaces	Design tools/Quality of the physical environment/Institutional Culture
Ineffective design evaluation, implementation systems and lack of demonstration projects	Integrated approach to enhanced the interior space requirements and ambience	Design tools/Operational Organisation/ Perception
Poor approach for workload prediction and design briefing	Functional floor layout design, room sizes, space utilisation and improved built form	Design tools/Institutional culture/ Perception/Ambience
Need for standardisation of design, construction and POE protocol systems	Better multiple space use and improved floor layout configuration	Design tools/Perception/Institutional culture
Lack of guidelines for sustainable design solutions and measures to improve design, construction timeframes and budgets	Increased provision of the effective and efficient healthcare facilities within budget	Quality of the physical environment/ Social integration
Lack of use of technology for design, construction and operational systems	Recognition of the impact of technology in improving space design, provision and implementation approach of these facilities	Design tools/Quality of the physical environment/Institutional culture

6 CHAPTER SIX

DGAEF IN PRACTICE: CASE STUDY OF CHRIS HANI BARAGWANATH HOSPITAL

6.1 Introduction

This chapter presents the analysis and findings of the interviews, floor plan analysis and observational studies carried out at Chris Hani Baragwanath Hospital (CHBH) A&E facility. The findings are analysed within the framework of the thematic categories identified in Chapter Two—design tools, quality of the physical environment and perception, and are also compared with findings from similar studies. This chapter comprises three main sections:

Section A presents the results of the interviews and contains three main parts. The first summarises the respondents profiles; the second presents the respondents' views on the DGAEF; and the third discusses the structure of the DGAEF and an approach to their review based on Planetree principles (see 2.7).

Section B discusses the results of the floor plan analysis and is divided into two sections. The first discusses space functions and the criteria for floor plan evaluation, and the identified challenges relating to the DGAEF used for space design and provision. The second explores the structure of the DGAEF update based on the Planetree principles.

Section C discusses the results of the observational studies and observational techniques of Space Syntax. It comprises two parts: the first describes the influence of the DGAEF on the quality of the physical environment and interior ambience; and the second explores the structure of DGAEF based on the Planetree principles.

The chapter ends with an overview and tabulated summary of the emerging issues.

A. RESULTS OF THE INTERVIEWS

6.2 Respondents' profiles

Fifteen (15) males and eight (08) females, selected through purposive sampling,[48] were interviewed. The consultants' category included architects; civil/structural engineers and quantity surveyors; and the caregivers category included physicians, nurses and clinical managers.[49] The subjects from Gauteng Provincial Departments of Health and Public Works included directors, senior and junior staff. Educational background was used to select participants in the patients/community members category. Respondents' ages ranged from 25 to 66 years and above as Table 6.1 shows.

Table 6.1: Respondents profiles

	Consultants						Caregivers						Government						Patients						
	Architects A1, A2, A3		Civil/Structural Engineers CS1		Quantity Surveyors QS1		Physicians PH1		F/nurses FN1, FN2, FN3		Clinical managers CM1		Directors D1		Senior staff SS1, SS2, SS3		Junior staff JS1, JS2		Sec. School PS1, PS2		Diploma PD1, PD2		University Degree PU1, PU2		**Total**
Gender	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	
25-35 years										1										1	1			1	**4**
36-45 years							1			1							1						1		**4**
46-55 years		1					1			1	1		1		1	1		1	1		1				**10**
56-65 years	1				1										1										**3**
66 & above	1		1																						**2**
Total	**2**	**1**	**1**	**0**	**1**	**0**	**2**	**0**	**0**	**3**	**1**	**0**	**1**	**0**	**2**	**1**	**1**	**1**	**1**	**1**	**2**	**0**	**1**	**1**	**23**

6.3 Respondents' opinions on the DGAEF

The interview study explored the different stakeholder groups' opinions on the DGAEF through their responses on the following issues: awareness, use of and compliance to the DGAEF; influence of DGAEF in achieving healthcare facilities development goals; appropriateness of the DGAEF in meeting the current healthcare facilities needs; healthcare facilities space design and provision and quality of services delivery; and standardisation of project development processes and technology innovation.

[48] See section Chapter Four: 4.6.2 and 4.6.3.

[49] The schedule of questions for the semi-structured interviews with the different stakeholder groups are included in Appendices F, G and H..

6.3.1 Awareness, use of guidelines and compliance to the DGAEF

The question on level of awareness of the DGAEF reveals that most consultants have used DGs in the past for healthcare facilities projects, but the overall level of compliance is low.

Overview of the design tools in the DGAEF: The project briefing system, according to the respondents, is unclear, and a comprehensive research-based project briefing document is needed. The latter should be adapted, by design teams and healthcare institutions, to contextual requirements (A1).[50] This approach should facilitate improved healthcare facilities design (A3). New benchmarking tools for project budget determination should also be included in the DGAEF update as the project cost guidelines are no longer applicable (QS1).

Project briefing protocols, design solution and project implementation systems: The current workload estimation method, in particular at CHBH A&E, is outdated, confusing and uses flawed assumptions, according to FN2. Hence the need for an update.

> *"The data used for determining workload....are generally based only on data collected during normal working hours.....In A&E facilities where the doctors keep to normal working hours, local demand is not met appropriately since working people would like to attend the facility after hours...." (FN2).*

The consultants and caregivers' interviews revealed that another important component of workload prediction missing in the DGAEF is guidance on estimating time spent by patients in examination/treatment/resuscitation rooms. The average length of time a patient is in the room depends on the room type and on whether it is a minor or major A&E case (A3).

The participants argued that the briefing document should highlight issues relating to the healthcare facility's project vision, desired culture and operational systems. A1 noted that the general and specific design requirements can provide comprehensive information on space design and provision issues relating to functional suitability and spatial relationships. In addition, A1 suggests that detailed information on benchmarking tools are required for analysing legislative, technical and project costs during design process. Thus, the design tools

[50] A1...QS1...FN1...refer to the respondents presented in Table 6.1.

may consist of the following documents: project brief document; design solution approach and project implementation systems (A1).

6.3.2 Influence of DGAEF in achieving healthcare facility development goals

The interview findings reveal that programmes for completion of healthcare facilities projects are excessively long. The two major effects of these delays are:

(i) under expenditure of healthcare facilities budgets; and

(ii) poor provision of A&E facilities and over expenditure when they are built.

Design development approach and construction timeframe: The project programme depends on the size and type of A&E facility. A1 affirms that it took approximately five years from project briefing to completion of renovation works at CHBH A&E facility. On average, a L1 facility takes at least 3 to 4 years to complete. Regional healthcare facilities, Level 2 and 3, are on average completed within 4 to 5 years. Tertiary facilities take more than 10 years (A3). DGAEF update is vital to ensure that the following issues are adequately addressed: design, construction timeframes and budget overruns (D1 and SS2).

The effect of DGAEF on design documentation and project budgets: The interviews revealed the need for more detailed project technical documentation owing to numerous omissions in the bills of quantities, resulting in poor prediction of budget estimates for projects. The introduction of KPIs for measuring project technical documentation output and budgets, it was asserted, is critical, as it can improve the level of services delivery in A&E facilities (JS1). The interview examined the risk factor linked to ineffective and inefficient project development processes such as project escalation, variations that generally occur due to changes in technology and medical advancements (D1, SS1 and JS1).

6.3.3 Effect of inappropriate DGAEF on healthcare institution organisational culture

The findings reveal an interdependent relationship between DGAEF, design and the healthcare institutional culture. The respondents suggest that the DGAEF influence space design and provision that are inappropriate for present A&E facilities workflow processes. Most agreed that, through the DGAEF used for space design and provision, floor plan configurations can positively influence the current culture of healthcare facilities services delivery by improving the quality of spaces provided, accessibility, quality of services delivery and experience of the users.

Interdependent relationships between DGAEF, design and institutional culture: The respondents agree that a major challenge to the project development process is the system of conveying design information to the stakeholders. Generally, the design team produces information based mostly on an incomplete project brief from the client which has to be continuously updated during design and construction, as was the case in the CHBH project (A3). The design of a new facility, according to A1, offers a unique opportunity to healthcare institutions to re-align their organisational culture based on new trends in workflow processes; and also for the design team based on the findings from POE. The realignment of organisational culture can be based on continuous evaluation and feedback obtained through research on completed projects, procurement systems and from operational processes using POE systems (QS1).

According to D1, the information systems used during the design and construction phases contribute between 30 to 40% to total delay during project development processes, as documented during the implementation phase of the CHBH A&E facility. The information obtained from this investigation is supported by a similar study conducted by Gauteng Department of Public Works (2005). D1 and SS1 are of the view that communication protocols, procurement systems and project management tools may rationalise the construction timeframe and project cost, as well as the quality of the building. The consultants believe that the DGAEF update can assist stakeholders in developing procurement systems, communication protocols and project management tools to ensure improvement of project development processes.

The influence of DGAEF on design and operational systems-based perspectives: A3 affirms that the separation of design and construction activities is now outdated and constrains the provision of healthcare facilities to communities. There is therefore urgent need to integrate the following activities during project development phases: project briefing, design development, construction, commissioning and POE.

Most participants indicated that the construction industry involves mostly team-based work. All the actors are required to work in an integrated manner to ensure that the vision of the healthcare institution for the project succeeds. The client, design team and construction firms bring together complementary skills to achieve an outcome that could not be achieved by one team alone (A1 and CS1).

6.3.4 Healthcare facilities space design and quality of services delivery

The interview study findings reveal that the DGAEF focus primarily on value management process and minimum acceptable functional space areas and project costs, paying little attention to intangible issues such as "space design quality and aesthetics". The participants suggest that there is need to establish, through DGAEF update, evaluation systems for addressing the challenges relating to users experience and satisfaction (A1, QS1 and D1). According to A1 this could be achieved by improving the information systems in the general and specific design requirements for project briefing protocols (project scope, space narrative and room data); design solutions (space planning, design development and technical documentation) and project implementation (efficiency and effectiveness in communication, project management and construction systems).

Defining DQIs for project briefing protocols, design solutions and project development process: Participants' opinions on whether the information systems in the DGAEF are adequate to influence the design and construction of improved A&E physical environments ranged from "completely inadequate" to "adequate". A1 affirms that there is need to introduce DQIs in the DGAEF to improve caregivers operations and reduce their stress during daily work shifts. This opinion is consistent with the argument in the literature that DGAEF can improve the spaces used for healthcare services delivery by addressing the following issues: caregivers' travel distances during work shifts and those of other users; location of supplies and equipment next to patient areas; space for family members in rooms; ablution facilities in the room; and easily surveillable spaces (see 2.7, 2.9 and 2.10).

Most participants supported the use of DQIs for evaluating: project briefing protocols, design solutions and project development process (A1, A3, FN1, FN2 and FN3).

DQIs for floor plan design and arrangement: Some participants indicated that the accommodation schedule and space requirements as described in the DGAEF are inadequate. The findings reveal the need for the introduction of a "fast track" area in the CHBH A&E facility. A1 noted that there are no general and specific design requirements for space programming of this important space in the DGAEF, and suggests that this area needs to be preferably not far from the waiting area, but accessible, from a separate triage space within the A&E facility.

The project brief for the renovation work at CHBH A&E facility, undertaken using the DGAEF, recommended a floor area of 450 m^2 for the overall department. On completion of the estimation of overall area based on the accommodation schedule provided and workload prediction, the actual area required was 1,200 m^2 (A2). Therefore, the current space needs based on today's A&E operational system are between 120% and 130% more than the recommended area in the DGAEF. The respondents views are in line with the findings from the literature on the need to introduce DQIs for floor plan design and arrangement in the DGAEF update (see 3.18.1).

6.3.5 Standardisation of project development processes and technology innovation

The question of the use of standard project development tools in the DGAEF raised several concerns among the consultants. The idea is, however, plausible, according to A1, and is gaining ground among stakeholders as it can provide benchmarking systems for continuous evaluation of design tools (project brief, design solutions and project implementation systems), quality of the physical environment (integration of space design with A&E operations and engineering services, and quality of materials, finishes and technical performance) and perception (spatial relationships, level of satisfaction and quality of services delivery). Standardisation can thus improve end-product quality, project time and cost management, and experience and satisfaction of users (A1, A3 and FN2).

The effect of DGAEF on the quality of the physical environment: The participants agree that standard project development tools used for renovation works at the CHBH A&E facility were successful. CS1 indicated that the use of standard project development tools can encourage the use of efficient and effective buildings systems, to ensure the improvement of the quality of the product, time and cost. The caregivers believe that, due to constant changes in daily peak workload, critical issues facing A&E facilities today can be improved by the introduction of flexible and adaptable project development tools. In addition, the use of technology may encourage the introduction of KPIs to facilitate the use of integrated project development systems (PH1 and FN2). The participants affirmed that technology innovation may provide adequate information systems required for the introduction of DQIs for universal rooms in the A&E facilities.

The importance of DGAEF on use of standardisation and technology for design: The findings reveal that there is need to develop general and specific design requirements for hard[51] and soft[52] technology in the DGAEF update. According to CS1, this can create a

[51] "Hard technology" refers to the use of technological solutions for the construction and control of physical environment space quality such as: pre-assembly of construction elements or components; monitoring of air quality; ventilation; lighting levels; window opening; temperature; auditory; privacy and television.

culture of standardisation of construction elements and processes for healthcare facilities projects. Moreover, introducing standard building systems in the DGAEF can simplify budgeting issues and improve project budget prediction. Current projects, whether finished or under construction, by the Department of Health have overrun the estimated initial project costs by at least 30 to 60% (QS1). This new approach may offer significant benefits in terms of cost prediction and construction timeframes (CS1).

The participants see the use of standard project development systems as a solution to pertinent issues such as improving project briefing systems; reduction of documentation time and addressing skills shortages (A1, A3 and D1). The caregivers also believe that standard project development systems can address constant changing workloads prediction, multi-use space, functional relationships and integrated services (FN1, FN3 and PH1). Standard project development protocols can facilitate solutions for aesthetics of the healthcare environment, which relates directly to the quality of the interior design (choice of the finishes, materials and colours) (A3). The consultants and caregivers consider the general and specific design requirements for the interior environment an important missing component in the DGAEF.

6.4 Participants' opinions on DGAEF update based on Planetree principles

In addition to identifying challenges and gaps in the DGAEF, the interviews point to strategies for implementation of the new approach to DGAEF update.

6.4.1 Influence of DGAEF on healthcare facilities and social support spaces

There are no general and specific designs requirements in the DGAEF for the provision of social spaces that may influence users' experience of the healthcare facilities. Providing adequate information systems can promote awareness of the need for the introduction of design requirements for these spaces in the DGAEF update. The introduction

[52] "Soft technology" refers to the use of software programmes to assist in estimating the number of examination/treatment spaces required for the design of the healthcare facility, and for computing preliminary estimates prior to space planning. It can be a useful tool for government staff and consultants, and especially for inexperienced professionals.

of social interaction spaces is necessary, even if some healthcare institutions are against it because of management issues and the additional costs to the project (A3).

The influence of the space provision on the quality of physical environment and services delivery: A2 affirms that the space design and provision of any built environment reflects the values and culture of the healthcare institution. This is felt once inside the building; hence, the quality of the physical of environment should be given careful attention to promote the vision and culture of the organisation (D1).

The importance of DGAEF for social support spaces and quality of services: Providing information in the DGAEF on the design of social spaces, according to A3, can address the challenges of long waiting times for patients/families/visitors, and also may provide positive measurable outcomes in terms of quality of healthcare services delivery. Most of the respondents suggested that information systems for space design and provision of the following social spaces may be included in the DGAEF update: separate staff and patient circulation routes to deal with overcrowding and improve workflow process; caregivers' rest/changing/entertainment rooms; and resources use efficiency (FN1, FN2 and A3). The introduction of resource centres/libraries in the DGAEF update was also suggested, because of the sometimes long waiting times at A&E facilities.

6.4.2 The vital role of participatory approach in DGAEF update

Participation of stakeholders is important, and their opinions can be sought through consultation and included in the update of DGAEF (D1). Academics, caregivers and the community should also be invited to participate (A1, A2, A3, D1 and FN1).

Impact of DGAEF on a patient/staff/visitors centred design approach: Most of the participants identified the following as the main project briefing documents required for successful design of healthcare facilities projects: project scope, space narrative, accommodation schedule and room data requirements (A1, A3, PH1 and FN2). These documents are interrelated, and outline the operational processes of healthcare services delivery and the desired culture of the healthcare institution. It is important that room space requirements are obtained from caregivers/patient/visitors during the pre-design stage through broad based consultation. An inclusive participatory approach can stimulate positive attitude and behaviour of users; and can also help create a sense of knowledge identity, obligation, influence, involvement, ownership and attachment to the facility (PH1).

Space design, provision and furniture/equipment requirements: Most participants recognise the utility of obtaining the requisite information on space design and provision, functional suitability and spatial relationships through a participatory approach involving the users' (CS1, A2 and QS1). Without a good understanding of the space, equipment and furniture requirements, the design team are less likely to accommodate users' needs. It is therefore important to use information systems obtained through a research-based participatory approach for defining the general and specific design requirements for space design and provision, furniture and equipment in the DGAEF update (A2).

6.4.3 Introduction of DQIs for universal rooms design in the DGAEF update

The participants agree that evidence-based DGAEF can contribute positively to improving the physical environment, but have varied opinions regarding the built environment variables that contribute to operational processes and patient comfort. The consultants are in favour of standardisation of rooms based on the universal room space design concept in order to ensure that all rooms provided can be used as a multi-use spaces. According to A1, multi-use spaces should be used to address the issues relating to the need for additional spaces for speciality units—such as, chest pain, occupational health, poison control and burns—in A&E facilities.

The influence of physical environment on A&E operations: The participants have diverse views regarding the use of the universal/private rooms in A&E clinical and observation areas. Some are not in favour of private rooms, preferring to maintain the existing operational processes and high building costs. Indeed, resistance to change continues to influence the use of the open cubicle floor plan arrangement in A&E facilities in South Africa (A1). There is, however, increasing interest in the use of universal rooms, following studies showing a reduction of HAI in some healthcare facilities where they have been adopted (A1).

Multi-use rooms and speciality units in A&E facility: According to the caregivers, A&E facilities are the entry point into the health system for many patients, especially the under-privileged. CHBH A&E facility is attended mostly by people with no access to constant medical check-ups, but has limited human and financial resources (P4 and P5). Therefore, providing multi-use spaces can provide a solution to the acute shortage of spaces in this facility (P4 and P5). However, D1 argues that multi-use spaces should be provided in private sector run healthcare facilities since public sector healthcare institutions will not have the staff and budget to manage these spaces efficiently and effectively. According to A3, the general and specific design requirements should be flexible as every A&E unit is different and should reflect communities' needs and resources.

6.4.4 Influence of DGAEF on technology innovation, space design and operational processes

The findings reveal that the overall spaces provided at CHBH A&E facility are 60% less than what is required. But through an innovative design approach and creative operational strategies, an average of 350 patients are treated daily. The findings of POE done by A3 at this facility concluded that the design approach, despite providing inadequate spaces and not complying with Planetree principles, may be considered innovative.

Space design and provision, functional suitability, spatial relationships and interior ambience: Several studies show that using design concepts for flexible and adaptable spaces is necessary and no longer an option (A3). Most respondents believe that DGAEF can establish new methods for space programming for design and provision of examination, treatment and support spaces in A&E facilities; and that research-based information systems in the DGAEF can provide DQIs for integrating spatial arrangements with A&E operations and engineering services, quality of materials and finishes, and technical performance of the built environment. These views are consistent with those in the literature and questionnaire survey.[53]

Most participants think that the DGAEF can provide solutions for addressing the current challenges of overcrowding of A&E facilities in South Africa (PH1, FN2 and FN3). New trends in healthcare facility design show that DGAEF have to be frequently updated through innovative general and specific design requirements. The use of information and communications technologies (ICTs) can no longer be ignored, as it can facilitate the update process, so as to improve the quality of the physical environment, and caregivers operational processes and performance (A3).

Quality of the clinical/observation/support spaces and POE: The participants agreed that POE is an effective way of auditing performance and should be undertaken at the start of any new project in the spirit of learning (A3 and CS1). QS1 affirmed that prescriptive components of the project brief should be informed by lessons learned from previous projects, and incorporated and adapted as appropriate in the next project.

6.4.5 Introduction of comparative measures to improve project development process

The participants are of the view that the outcome of the completed CHBH A&E facility was due to poor project briefing from the Gauteng Departments of Health and Public Works. The majority see project briefing, design and construction as interrelated, interdependent and interconnected, and a continuous process (A1, A2, A3 QS1). According to A2, development of a good design brief is at the heart of understanding the client's needs.

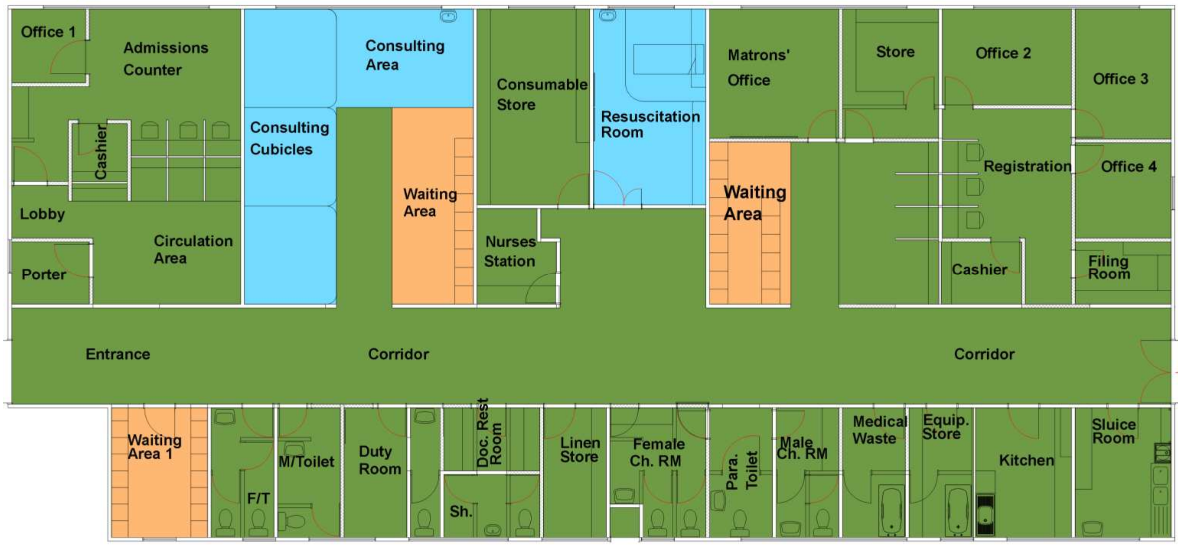
New approach to the update of the DGAEF using POE: Some participants noted that the project development process begins with the strategic briefing document, focusing mainly

[53] See Chapter Two: 2.6, 2.7 and 2.8; and Chapter Five: 5.3, 5.4, 5.5

on organisational decision making processes and preferred workflow processes in order to optimise efficiency and effectiveness of resources use and capacity efficiency (D1 and A2). In this respect, POE can provide valuable information for updating, repeating and innovating opportunities for improvement of DGAEF (A3).

B. RESULTS OF THE FLOOR PLAN ANALYSIS

The CHBH A&E facility floor plan in Figure 6.1 below was analysed to answer questions on the impact of the DGAEF on floor plan configuration, including the effect of the floor plan configuration on the pattern of staff/patients/visitors movements from arrival at the entrance to the triage, through to the examination and treatment spaces; capacity efficiency and caregivers' workflow processes in relation to quality of services delivery. As mentioned earlier the floor plan of this facility was categorised into four key functional areas: Zone A (entrances, waiting, triage and pre-examination); Zone B (examination and treatment areas); Zone C (inpatient areas); Zone D (support areas: administration, pharmacy, staff areas and visitors areas).



Legend

ZONE A   ZONE B   ZONE C   ZONE D

Figure 6.1: CHBH A&E facility - Floor plan layout

The relationships between space design, desired adjacencies and DGAEF were evaluated using the 'Floor Plan Analysis Data Collection Protocol Sheets'[54] and HTA, LA, AutoCAD, and Space Syntax techniques, which are explained in Chapter Four (see 4.7.1). The analysis was guided by the three themes that emerged from the literature review, questionnaires and interviews—design tools, quality of the physical environment and perception (see 2.13).

6.5 The effect of the DGAEF on space design and provision

The following variables for DQIs were used to analyse the spaces provided in zones A, B, C and D designed with the DGAEF currently used: space provision/design; functional suitability/ utilisation and space relationships.

6.5.1 ZONE A

Entrances, reception/ waiting, and triage/pre-examination areas

The spaces evaluated within Zone A are arrival/entrance; reception/waiting and triage/pre-examination areas.

Arrival and entrance: The main functions of the entrances are to welcome people into the A&E facility, and to control access into the facility and other departments. The two entrances provided at CHBH A&E unit are located opposite to one another. The main entrance is used primarily for both walking and recumbent patients, while the other leads to the main healthcare facility. There are limited obvious wayfinding systems within the A&E entrances; and those available are not clearly visible. The security and search areas are not located in the entrances; there is no porter's area; and trolley and wheelchairs park areas are outside the entrance area. Comfortable seating and convenient spaces to put personal belongings, which are normally located at the entrance area, are also not provided.

[54] See Appendix I.

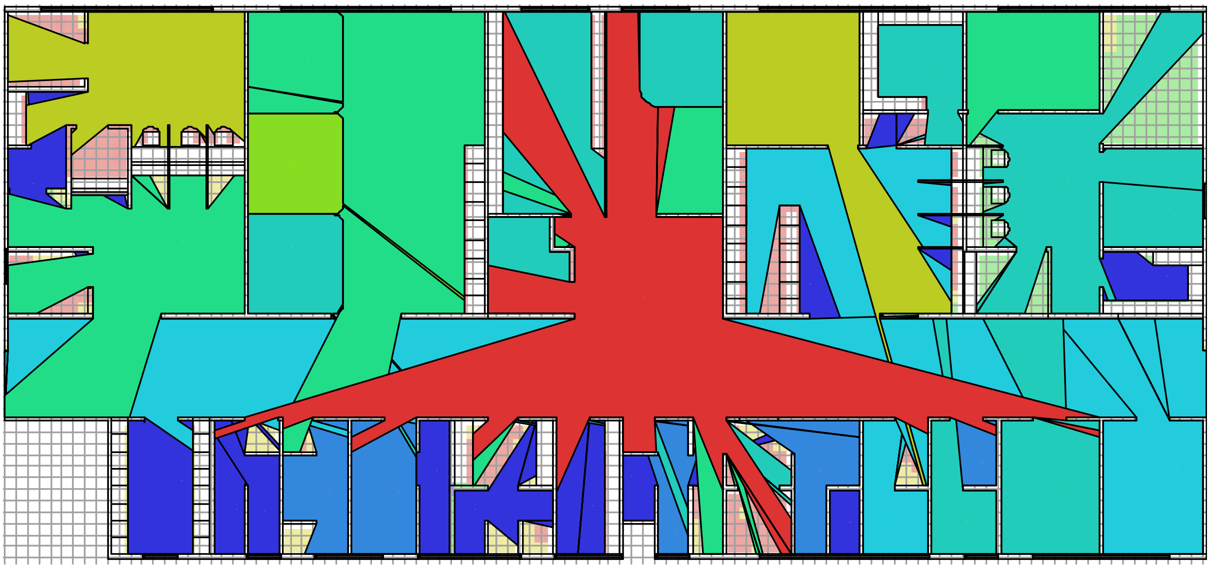
Reception and waiting: The reception and admissions areas are respectively located at the main and ambulance entrance areas. However, based on estimated daily average attendances, the space provided for each is inadequate. There are three waiting areas located off the main circulation areas in the admissions, consulting and registration spaces respectively, as shown in Figure 6.1. There is no space dedicated for wheelchairs users, trolleys and pushchairs, or children's waiting/play area. However, the design of the waiting areas allows for easy access to public toilets, baby change room, light refreshment facilities (such as snack and beverage dispensing machines) and public phones.

Triage and pre-examination areas: There is no triage space—assessment of patients is conducted in the examination and treatment rooms. These areas are used mainly to perform pre-examination and provide first aid in a private and secure environment. The triage and assessment areas are generally located where staff can observe and control access to the treatment areas. The pedestrian and ambulance entrances and public waiting area are located adjacent to the triage and assessment spaces. These areas are visible from the reception, waiting, ambulance entrance and the children waiting/play area.

Space design and provision: The design factors directly affected by the design tools in the DGAEF used for space design and provision are: spatial organisation and openings/penetrations. The DQIs used to measure these design factors are: (i) access control; (ii) wayfinding and (iii) surveillance of waiting areas/rooms.

Space organisation and openings/penetrations: Patients are streamed into this facility according to the following categories: minor or major illness/injuries. Hence, the design and location of entrances needs to facilitate and manage this separation. However, the ambulatory and recumbent patient entrances are opposite to one another. Consequently, on average less than 10% of ambulatory patients use the recumbent patient entrance.

Isovist-based visibility analysis of the floor plan was used to benchmark surveillance and identify the number of spaces visible in Zone A from the staff base. Isovist measures refer to the level of radial views in order to ensure maximum visibility and surveillance of a space (Hiller and Hanson, 1984). As the visibility graph analysis done with Space syntax isovist measures in Figure 6.2 shows, measures vary greatly in entrances and waiting areas; for example, from 0% to 20% to as much as 95% in the waiting area opposite to the main reception and admission area. The analysis confirms that the reception and waiting areas are not directly visible from the main entrance.



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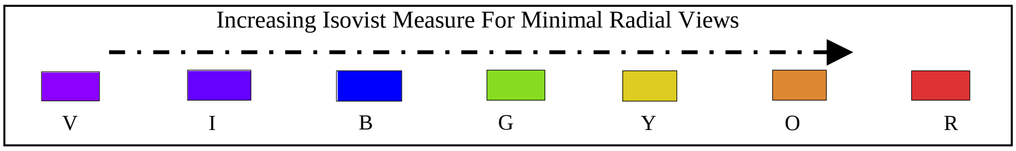
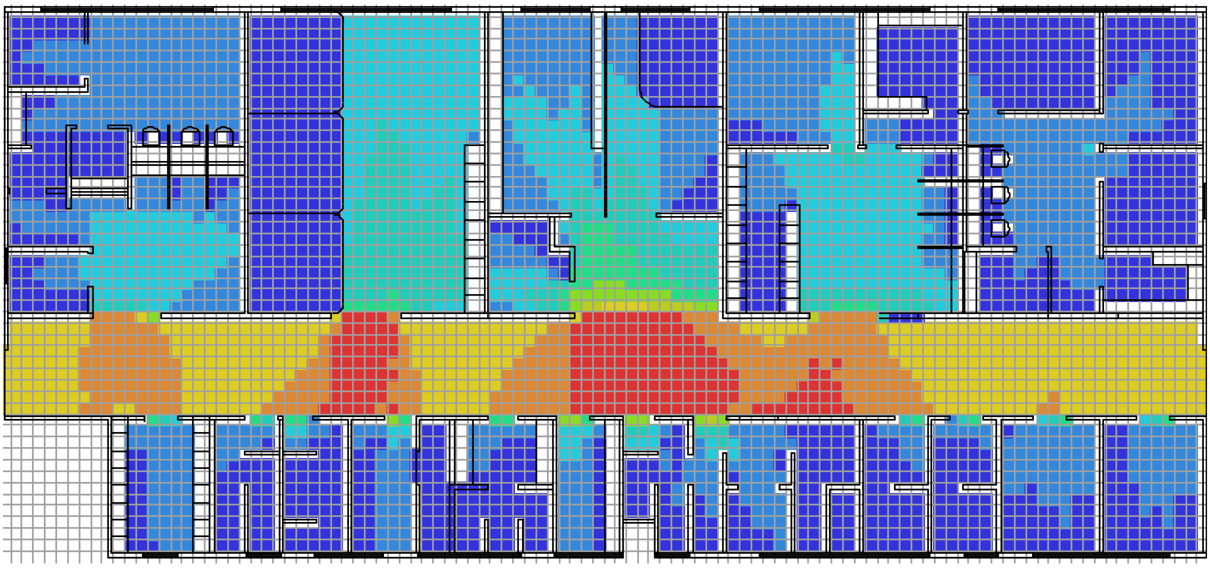


Figure 6.2: Space syntax analysis - Isovist measures

These findings are confirmed by the visual connectivity analysis in Figure 6.3. Connectivity of spaces represents the degree to which spaces are linked. Visibility modelling of the space plan that is represented by the connectivity diagram shows areas of both maximum and minimum connectivity between the spaces on a decreasing scale (Hiller and Hanson, 1984).

Even when spaces needs privacy to concentrate and perform certain task, users also value the ability to stay connected with the surrounding, not only because of their inherent interest in human activity and interaction but it is important to know what is happening around. For example, in a A&E environment knowing who is coming and going is important for surveillance purposes. And the caregivers need also to prepare for certain case priority as it is vital for effective and efficient healthcare services delivery. Rengel (2007), argues that even though that these types of connections are often desirable, deciding when to provide connection and how much to provide are difficult design decision issues since the optimal degree of connection will vary from spaces to spaces. Therefore, providing evaluation criteria in the DGAEF relating to visual connectivity and surveillance of the spaces designed and provided may be necessary.



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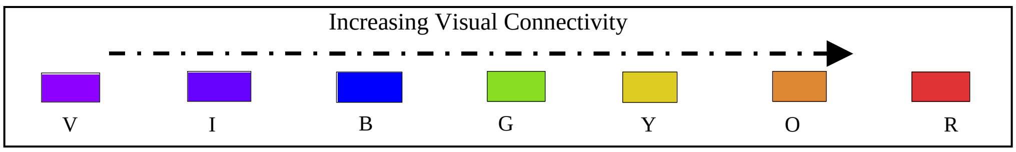

Figure 6.3: Space syntax analysis - Visual connectivity

Functional suitability, utilisation and spatial relationships: The DQIs used to evaluate space functional suitability, utilisation and spatial relationships in this zone are circulation systems; adjacency matrix and level of spatial autonomy. The DQIs were analysed using HTA, LA, and Space Syntax techniques to determine the influence of the DGAEF on the floor layout configurations.

Circulation, adjacency matrix and level of spatial autonomy: The circulation spaces in Zone A comprise less than 20% of the overall area in this space. The main users of this space are: visitors 45%; patients 40% and caregivers 15%. The space functional adjacencies and level of spatial autonomy evaluated with HTA and LA observed that there is inadequate space provision at the entrance, reception and admission area; no space provision for triage/pre-examination area and the total area provided for waiting is 5% of the A&E total gross area. The findings underscore the importance of the spatial configuration of the floor plan layout of the A&E facility in relation to the quality of healthcare services delivery.

6.5.2 ZONE B:

Examination and treatment areas

The DQIs used to analyse the floor plan arrangement in Zone A were likewise used to evaluate the spaces provided in Zone B, and measured location, size and integration of the provided spaces with services (mechanical and electrical installations).

Space provision and design: Only four examination and treatment rooms are provided in this facility; which is inadequate to handle the current daily number of patients that have to be attended to. The examination and treatment rooms are thus used as multi-use spaces, to enable caregivers to cope with the daily workload. The examination and treatment rooms are split into five categories: minor rooms; major or stretcher rooms; resuscitation rooms; paediatrics rooms and other (psychiatric, gynaecology and legal cases—rape, assault and drunkenness).

Space organisation and openings/penetrations: The spatial organisation and room dimensions comply with the recommended minimum room size of 6 m^2 in the DGAEF currently used. However, they are inadequate when compared to current trends in A&E workflow processes based on Planetree principles. Moreover, open cubicle cluster arrangements have limited space to accommodate equipments/supplies and family/visitors areas; and have the following constraints: very low auditory privacy; low visual privacy and lack of surveillance from the staff base.

Functional suitability, utilisation and spatial relationships: The space programming variables—number of rooms, circulation, adjacency matrix and level of spatial autonomy—were used to evaluate the following DQIs: space functional suitability, utilisation and spatial relationships in relation to patient surveillance, privacy and dignity.

Number of rooms: The information in the DGAEF for estimating the number of rooms is inadequate; hence rule of thumb is applied when determining these spaces. The DGAEF provide an area linked department gross area which is based on the number of patients in three-hour peak periods. This is 430 m^2 for the first 60 patients; which should be increased by 100 m^2 for every additional 50 patients.[55] These findings reflect the assertion in Chapter Three that this information is inadequate for estimating the number of rooms required in Zone B.

Circulation, adjacency matrix and level of spatial autonomy: Figure 6.4 below shows the results of Space Syntax shortest path distance, HTA and LA used to analyse movements of people, equipment/device and furniture with AutoCAD to draw the link diagrams as output to communicate spatial information required for simulation trials. This investigation confirms that the circulation spaces in this facility, comprising less than 15% of the total gross area, comply with the DGAEF requirements for circulation area. However, analysis identified the following problems: lack of separation of circulation spaces, with patients/caregivers/visitors using the same circulation; location of support and ancillary areas off the circulation; and long

[55] See Chapter Three: 3.17.2

travel distances for caregivers. These findings are in line with the results obtained from the interviews and literature.[56]

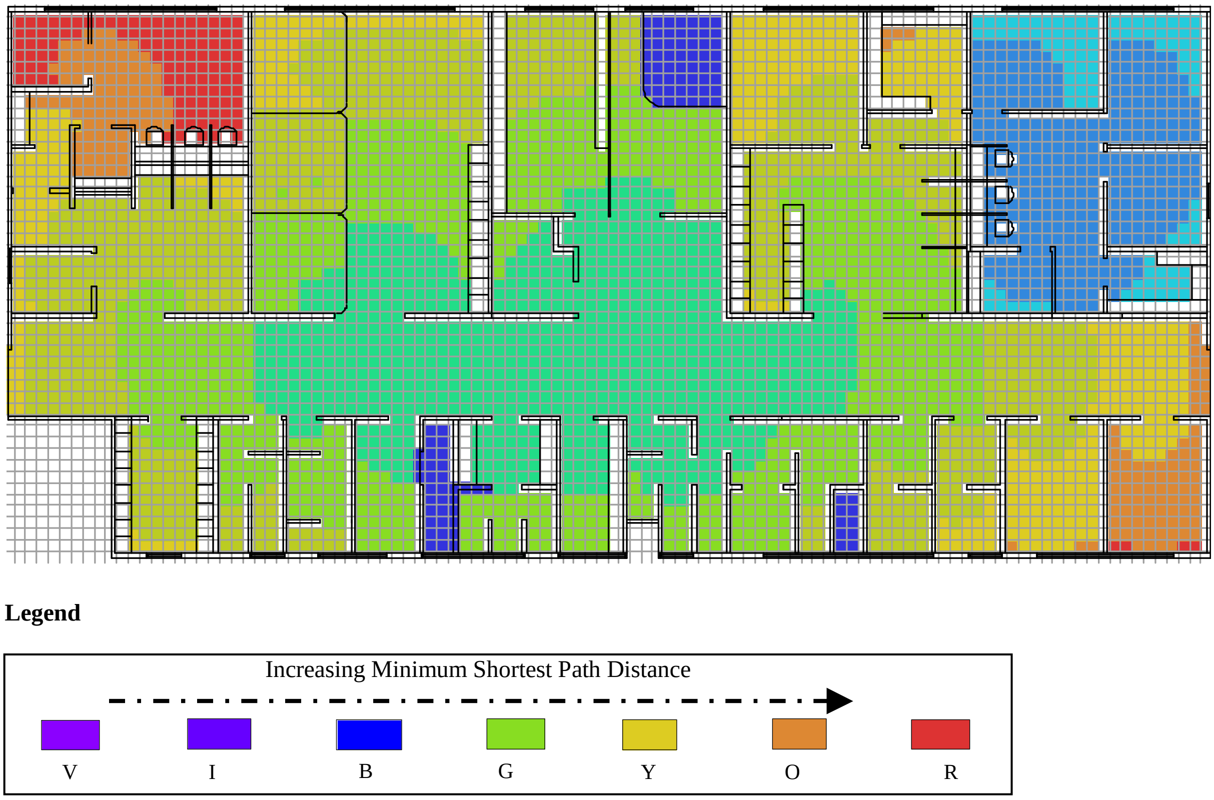

Figure 6.4: Space syntax analysis - Shortest path distance

6.5.3 ZONE C:

Short stay inpatient area

The DQIs for space design and provision in Zone A were also used to evaluate the influence of the DGAEF on space design and provision of the short stay inpatient units.

Space provision, design, spatial relationships and utilisation: Currently, patients requiring further clinical attention after being treated in the A&E facility are transferred to the existing inpatient nursing areas, the floor plan layout of which is based on Nightingale's guidelines. The space programming variables used in Zones A and B were also used in Zone C to measure the same DQIs: space organisation, estimation of number of rooms, adjacency matrix and spatial autonomy.

[56] See Chapter Two: 2.6.4; Chapter Three: 3.18.2 and Chapter Six: 6.4.3.

Space organisation, estimation of number of rooms, adjacency matrix and spatial autonomy: The result shows that the overall core bed area is 2.4 m (width) x 2.6 m (length). The location of the sanitary facilities at the end of the straight long corridors creates long travel distances for both patients and staff. The 3.0 m wide circulation spaces, in relation to core bed space, are considered inadequate, and are, moreover, used as ad hoc storage area.

The multiple-bed room arrangement with curtain enclosures around the core-bed space compromises patients' privacy and dignity; clinical treatment area; personal care space; circulation space; and space for family members. The average core bed area of 6.24 m^2 complies with the minimum patient space standard in the DGAEF currently used, but is inadequate compared to minimum inpatient accommodation areas in UK and USA of 25 m^2 and 28 m^2 per bed respectively.

6.5.4 ZONE D:

Support areas: (staff facilities and ancillary spaces)

The support and ancillary areas analysed were grouped into three categories: administration areas (nurse's station; offices; doctor's and nurse's office); sanitary facilities (patients/visitors ablutions; staffs change rooms and ablutions) and storage (linen stores; consumable store; equipment store and kitchenette). The same space programming variables discussed above were used to evaluate the spaces provided in Zone D using the same DQIs: space provision and design; functional suitability and utilisation and spatial relationships. The poor scores obtained are consistent with the findings in Chapter Five and the literature.[57]

Space provision, design, spatial relationships and utilisation: Using the general and specific design requirements in the DGAEF, four offices have been provided, which is inadequate for the functions they are required to fulfil. The caregivers' rest area and change rooms with ablution areas are also poorly designed and located, as are the storage areas

[57] See Chapter Two: 2.5 and 2.6; and Chapter Five: 5.4.4.

(equipment, linen, consumable, medical waste and housekeeper's room) which are located off the main corridor.

The areas in this zone—rest and recreational spaces; overnight accommodation; changing rooms with associated facilities; offices; education and training facilities and storage facilities—were analysed in relation to these DQIs: space organisation/utilisation and adjacency matrix/level of autonomy. In addition, HTA, LA and Space Syntax techniques were used to evaluate the influence of DGAEF on the floor layout configuration.

Space organisation and utilisation: Space Syntax visual entropy was used to analyse the spaces in zone D and to evaluate nurses' tasks at the reception counter. It refers to a measure of the distribution of locations in terms of their visual depth from a node. The visual depth from the node provides points of reference to help people orient and navigate the spaces easily and have a sense of where they are (Hiller and Hanson, 1984). The Space Syntax visual entropy was determined through visibility modelling as shown in Figure 6.5.

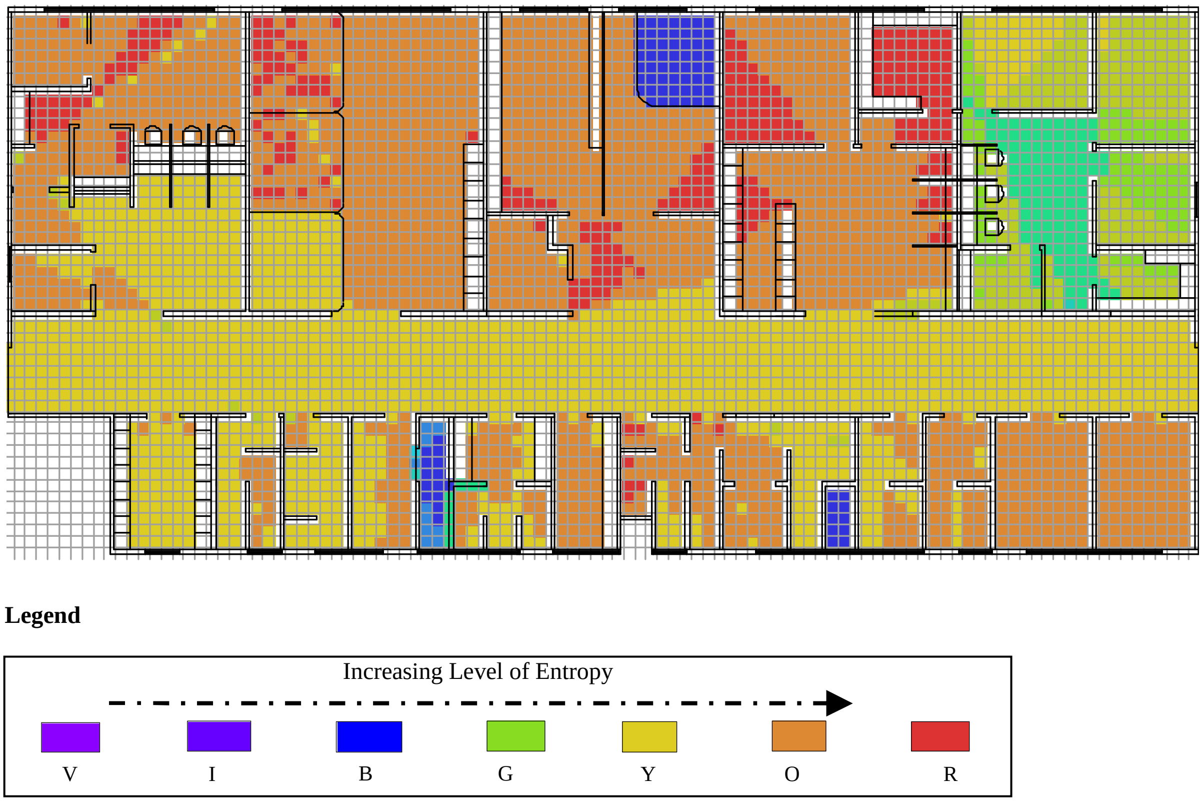

Figure 6.5: Space syntax analysis -Visual entropy

The findings reveal that the floor plan configuration constrain nurses from effectively performing their administrative duties. The number of staff change rooms and ablution facilities provided, based on the daily staff population, is inadequate. The space design and provision of the stores are incompatible with current A&E operational processes and are also not in accordance with Planetree design principles. This suggests that designing these ancillary areas without consulting the users impacts negatively on workflow processes.

Adjacency matrix and level of autonomy: The findings reveal that locating stores and other ancillary spaces poorly affects the outcomes for medical attention and capacity efficiency. Moreover, the location of most of the stores means they are not directly under nursing staff control; and the design of the stores is inefficient in space utilisation.[58]

6.6 Floor plan analysis based on Planetree principles

The design and operational challenges faced in using the DGAEF and emerging issues for their update, based on Planetree principles, are discussed below:

6.6.1 The influence of DGAEF as tool for communicating project vision and objectives

A new building embodies change, whether knowingly or not, as asserted by Worthington (2001). Therefore, the task is to establish communication processes to ensure that appropriate systems are developed for managing change to achieve quality design through the improvement of the following design tools in the DGAEF: project brief definition, design solution and project implementation systems.[59]

Project brief definition: The poor scores obtained for the floor plan arrangement of the CHBH A&E facility suggest inadequacies in the project briefing document. These results are in line with the findings from the literature review, questionnaire surveys and interviews.[60]

[58] Narrow tunnel-like store rooms are inefficient and should be avoided; square or nearly square are preferable.
[59] See 2.9, 2.10, 3.13, 5.3, 5.4, 6.3 and 6.4.
[60] See 2.9, 2.10, 3.13, 5.3, 5.4, 6.3 and 6.4.

Definition of project scope, space narrative and room data requirements: The results of the floor plan analysis concur with the assertion in the literature that the definition of the scope of work, space narrative and space requirements should be obtained from "design operational systems based perspectives" through a research process.[61] The findings reveal that space design and provision in Zones A, B, C and D comply to the requirements in the DGAEF. However, when analysed using the DQIs for patient/staff/visitors centred facilities, the scores achieved for space design and provision, functional suitability and space relationships range between poor to medium. These findings place project brief definition at the heart of quality design, efficient and effective resources use, improved operational processes and quality healthcare services delivery.

Room data requirement, furniture/equipment schedule and budget: The findings shows that the sizes of the spaces provided comply with the DGAEF; but when analysed in relation to Planetree principles of care, they are inadequate.

6.6.2 The influence of DGAEF on efficient and effective A&E facilities

The DGAEF lack information systems to encourage stakeholders to address integration, distribution, equity, attachment and value for money for the overall project development process. Hence, lack of strategic thinking has led to use of obsolete project development processes in the development of A&E facilities, resulting in a poor end-product, as the CHBH A&E facility evidences. The findings suggest that the lack of KPIs in the DGAEF for evaluation of space planning, design requirements, design development and technical documentation likely influenced the inadequate floor plan configuration of this facility, which has compromised efficient and effective operational processes.

[61] See 2.9, 2.10, 3.13, 5.3, 5.4, 6.3 and 6.4.

6.6.3 The influence of user participation in the project development process

The findings from the questionnaire surveys, interviews and floor plan analysis suggest that the lack of adequate spaces in the CHBH A&E facility is the result of inadequate user consultation during the project development process. The findings also point to the absence of good project briefing protocols and project development systems in the DGAEF.

Suitability of spaces, comfort and sustainability: The low scores obtained from the results of the floor plan analysis are consistent with the findings in the literature that using participatory design process improves workplace environment and, consequently, user satisfaction (see 2.9.3 and 6.4.2). The results of the studies of Zones A, B, C and D similarly suggest the need for efficient and effective design solutions that take into account A&E workflow processes.

The findings from the questionnaire surveys, interviews and floor plan analysis suggest that project development processes that focus on participatory design principles should address these concepts: identity; obligation; influence; knowledge and involvement. These findings are in consonance with the literature.[62]

6.6.4 The influence of DGAEF on technology innovation

As established in the literature review, DGAEF and quality of the physical environment are directly related. Hence the need to integrate general and specific requirements for spatial organisation with engineering services; design solutions for floor plan layout with A&E operations; and quality of materials and finishes with technical performance.

Designing integrated spaces with engineering services for multiple uses: The findings are consistent with the information obtained that the unbroken sequence of medical attention to patients adopted in this facility due to lack of space resulted in an approximately 10% increase in capacity efficiency (Chris Hani Baragwanath Hospital, 2006). This finding suggests that

[62] See Chapter Five: 5.4.2 and Chapter Two: 2.10.3 respectively.

information systems that can influence the design solution towards the universal room concept can have a significant impact in A&E facility space use and operational processes.[63]

Furthermore, the results suggest that incorporating procedures for the use of technology innovation in the DGAEF update is essential for addressing the following issues: changes in operational culture; adaptable and flexible spaces; and new trends in facility design. These findings are in line with the literature.

6.6.5 The influence of DGAEF on institutional transformation and operational systems

According to Berry et al. (2004), A&E facilities convey messages about the institutions' values and cultures. This study supports this view, arguing that the DGAEF used for the project development of this facility could have influenced institutional and operational decisions. The poor results obtained on evaluation of zones A, B, C and D suggest that space design and provision should focus also on addressing healthcare institution vision and objectives with particular emphasis on: accessibility; operational process; procurement; continuity; contract documentation; communication; management and experience.

Contract documentation, communication and management of project implementation: The findings reveal that the appointment of a construction management firm by the Gauteng Department of Public Works to act as the main contractor managing the SMMEs for this project was relatively successful. This innovative procurement system eliminated long bidding procedures required in the traditional procurement method, in which design is separated from construction activity. The benefits of using this procurement system include improved project coordination amongst the consultants and improved construction programme management. There are however risks associated with this procurement approach on issues relating to construction guarantees and management of defects liability periods for completed works, as highlighted in the literature survey and interviews.

[63] See 2.10.5 and 3.13.3.

6.6.6 Influence of DGAEF on standardisation of the project development process

The results of the floor plan analysis reveal a direct relationship between space design and the quality of the patients/staff/visitors experiences. The results also support the argument for introduction of KPIs in the DGAEF update for evaluating quality of the end-product and user satisfaction.

Quality of the product, time, aesthetics and satisfaction: Space design and provision should focus on fulfilling project development needs to address the huge backlog in A&E facilities in South Africa. The findings suggest the need for standardised project development tools to improve design and implementation of A&E facilities development projects. These findings agree with literature, surveys and interviews that more generic and flexible specific design requirements in project development documents can provide opportunities for developing innovative and improved project briefing, design solutions and project implementation processes.[64]

C. RESULTS OF THE OBSERVATIONAL STUDIES AND SPACE SYNTAX TECHNIQUES

This section presents the results of the observational studies and Space Syntax techniques conducted at CHBH A&E facility. Figure 6.6 shows the observation points used for mapping the caregivers/patients/visitors behaviours in conjunction with the observational tools in Appendices J, K and L, as explained in Chapter Four (4.7).

[64] See 2.10.5, 3.13.3, 5.3.5, 6.4.5 and 6.8.6.

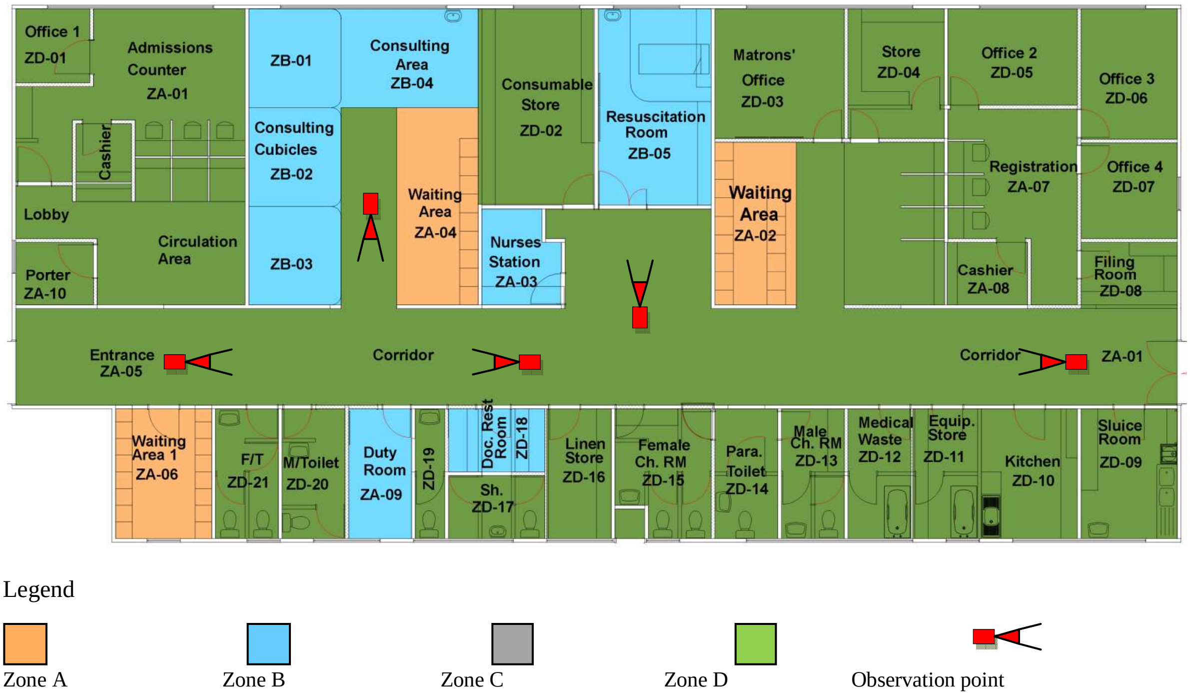

Figure 6.6: CHBH A&E facility - Observation points for space mapping

6.7 Influence of the DGAEF on the quality of the physical environment and interior ambience

Participant observation was used to evaluate the quality of the physical environment and interior ambience in zones A, B, C, and D, using the same DQIs: space provision/design; functional suitability/utilisation and space relationships. In addition, observational studies, in combination with behavioural mapping techniques (explained in detail in Chapter Four), was used to evaluate the effect of the DGAEF on capacity efficiency and services delivery.

6.7.1 ZONE A:

Space provision and design: The spaces provided and analysed within this zone are: arrival/ entrance; reception/waiting and triage/pre-examination areas.

Arrival and entrance: The reception and admission counters are physically separated from the two main entrances; the first of which is for trauma cases (P1); and the second for medical and non-urgent emergencies (P2 and P3),[65] staff and visitors. The general observation

[65] See 3.11.3.

is that the entrances are untidy and unwelcoming: this is the trend in most A&E facilities in Gauteng Province based on the findings from the exploratory visits conducted earlier in this study (see 4.4.7). A noisy and disorderly environment with constrained interaction with staff members was observed. The unpleasant physical environment and ambience has led most patients and visitors to use the ad hoc external waiting area outside the building which is less crowded and less smelly.

Reception and waiting: The two reception and admission counters located off the two main entrances are similar in design. However, the one located at the ambulance entrance is in close physical and visual proximity to the entrance making the families waiting in this area or in the corridor an integral part of the environment. The equipment and furniture at these counters includes computers, workstations, chairs, fax machines, copiers with stand and waste bins. The observation confirmed the need for lots of waste bins in and around this area due to the amount of trash accumulated within an hour of the observation.

The design of the waiting area follows the traditional design concept of row seating with benches. Stacking chairs are now also used since they can be easily packed together to permit more flexible arrangements. The interior design and material treatments for the walls, ceilings and door finishes in the entrances and waiting area are bland and characterless. The result of the interior design of this A&E facility agrees with the findings from the literature on the influence of the use of outdated DGs on poor measurable outcomes on space design and provision, functional suitability and the quality of the interior architecture.[66]

Triage and pre-examination areas: The physical environment observed around the entrance and waiting areas was disorderly and cluttered owing to the high number of patients daily and absence of triage and pre-examination areas. This observation is in line with the information obtained from CHBH (2006) and the literature on the high daily volume of

[66] See 2.13.2; 3.13.2 and 6.3.

patients and visitors in this area, and consequent need for triage/pre-examination areas in A&E facilities.[67]

The impact of DGAEF on space provision and design was also evaluated based on spatial organisation and openings/penetrations. The DQIs used to measure these design factors are access control, wayfinding and surveillance of the waiting area/rooms.

Space organisation and openings/penetrations: The spatial organisation was evaluated using Space Syntax, HTA and LA in combination with space articulation,[68] inflection,[69] placement[70] and geometry. The measures used for evaluating the design of openings/walls penetrations in this facility focused on two main DQIs for evaluating interior design permeability: disclosure[71] and mobility[72] (see Appendices P, Q, R, S).

The space organisation and articulation are based on floor areas as required in the project brief and DGAEF. The results of this investigation obtained low scores for spatial disclosure analysis while the highest scores for mobility of the spatial arrangement were medium. The findings are in line with those of the floor plan analysis that the degree of visibility and surveillance of entrances and waiting from the reception varies greatly from poor to average (see 6.3.2).

Functional suitability and utilisation: The information gathered regarding space provision, functional suitability and utilisation were analysed using space use and occupancy level; space activities/workflow process; and access/circulation/time. Continuous interval observation recording sheets were used to record participants' behaviour. The measures used

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[67] See 3.12.1; 6.3.4 and 6.7.1.

[68] Articulation measures the degree of modification spatial organisation from planes or volumes by their skilful modulation into clearly expressed subparts to facilitate legibility add interest, afford order and rhythmic composition (Rengel, 2007).

[69] Inflection measures the degree of deviation from a given spatial organisation for instance when a straight scheme becomes angular or curved (Rengel, 2007).(Rengel, 2007)(Rengel, 2007)(Rengel, 2007)

[70] Placement measures of spatial arrangement based on HTA of each functions and relationships to each other. Public areas generally want to be in front while private areas can be tucked away and shared services centrally located (Rengel, 2007).

[71] Disclosure measures the degree to which a space and other spaces beyond are revealed as one moves within and around a defined space. The level of visual disclosure are determined by the number, type and placement of view-obstructing elements, whether they are permanent architectural elements or less permanent elements, such as furniture, equipment or plants (Rengel, 2007).

[72]Mobility measures the relative degree of freedom or restraint a particular spatial arrangement affords those who move within and around a defined space. Designers can control people's movement within a building system. The degree of freedom or restraint depends on whatever the floor plan configuration offers one route or multiple routes leading in or out the same space (Rengel, 2007).

to evaluate the information obtained are: Space Syntax, HTA/LA; entrance/exist counts; space use occupancy survey and also staff and patient pathways.

Space use and occupancy level:

Figure 6.7 shows the space use and occupancy levels of CHBH A&E facility by patients/caregivers/visitors in a daily average work shift. The results reveal that the A&E population in zone A is constituted as follows: visitors 45%; patients 40% and caregivers 15%. This finding confirms that the majority of the population in this area are visitors and patients while the caregivers are generally around the nurse's station or in the examination/treatment rooms.

Space activities/workflow process and access/circulation/time: The findings revealed that spaces provided in zone A comply with the DGAEF, but are inadequate. For example, there is no porter's and security facilities at the entrances. The space provided at the entrance area is inadequate for the number of people who come to the facility each day, thus constraining the main function of the entrance which is to meet and greet patients/visitors. In addition, the size of the space provided for the waiting area is also insufficient for the number of daily patients and visitors. The spaces provided for the waiting makes no provision for children's areas. This observation is in agreement with the findings in chapter five and Section B above (see 5.4.1 and 6.5.1).

The location of the support and ancillary areas off the main corridor is a major problem in the floor plan configuration of this facility as far as the caregivers are concerned. They would have preferred the support areas to be located in close proximity to the examination and treatment areas since journeys to these areas occur many times during a work shift and to reduce walking distance and time. These results agree with findings in the literature and Chapter Five regarding distances travelled by caregivers.[73]

[73] See 2.9, 2.10, 3.13.3, 5.4.3, 6.5.2.

The observed number of journeys made by caregivers to the support and ancillary areas in an average work shift ranges between 40 and 50. When these trails were measured, the distance travelled by each caregiver was between 1,000 and 1200 metres. Thus, valuable time that could have been better spent is wasted on journeys for supplies and equipment. This fact is supported by the findings in the literature and Chapters Five and Six.[74]

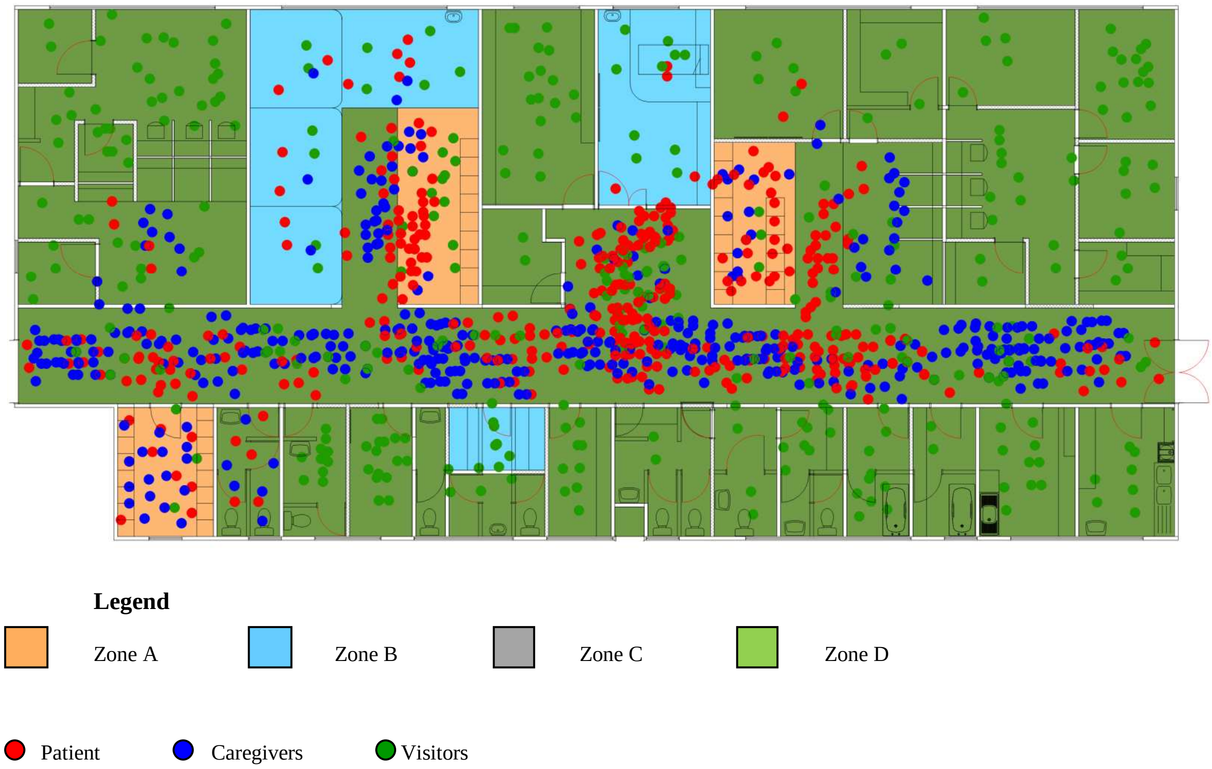

Figure 6.7: Space Syntax analysis - Space use and occupancy level

Spatial relationships and internal experience: The design and locations of the entrances, waiting and reception areas were evaluated in terms of their spatial relationships to one another. The quality of the internal ambience was measured using the following DQIs defined in the observation continuous interval recording sheet: adjacency matrix; level of autonomy;[75] internal finishes; quality of natural/artificial light; and use of colour/texture.

[74] See 2.9, 2.10, 3.13.3, 5.4.3, 6.5.2.

[75] Level of spatial autonomy measures the relative degree of connection and integration between spaces. There are various ways of joining spaces: no physical connection; off-side connection; direct connection; in-between connection; interpenetrated connection and semi-imposed connection. Level of connection influences the level of individual or group activities within a space and besides defines the level of interaction (Rengel, 2007).

Adjacency matrix, level of autonomy and interior ambience: The findings revealed that the spaces provided are fragmented and confusing. The spatial relationships are not well planned, thereby constraining the workflow processes of the caregivers in this zone. The findings suggest that the desired and necessary relationships , which can be identified through Space syntax, HTA and LA, were not adequately defined during project development. Therefore, the scores for adjacency matrix and level of autonomy were between low and medium as shown in Space Syntax visual integration analysis in Figure 6.8.

The interior space design analysis used the following KPIs: spatial modulation;[76] spatial texture;[77] and use of pattern.[78] The highest scores obtained on the level of interior design articulation/modulation and spatial texture analysis varied between very low and medium, and the scores for the use of pattern were very low. The scores obtained from the analysis of the natural and artificial lighting in this area are both 'poor'. Indeed, both natural and artificial lighting in this facility is inappropriate for the use.

6.7.2 Zone B:

Examination and treatment areas

The examination and treatment areas in Zone B were analysed using the same DQIs—space provision and design; functional suitability, spatial relationships and internal experience—and the same evaluation criteria as above.

Space provision and design: There are a total of four major and minor examination and treatment spaces at this facility as shown in Figure 6.6 above. The investigation revealed that 55% of the patients entered the major treatment rooms on stretchers or wheelchairs, while 45% were assisted by caregivers, family or visitors. The consultation and medical procedure with a patient generally requires between two to four caregivers and the use of space on all

[76] Spatial modulation measures the subdivisions of any element such as interior architectural elements into smaller components to form a whole (Rengel, 2007).

[77] Spatial texture measures the physical structure of the interior architectural materials: size; shape; density; arrangements and proportion of its elementary parts (Rengel, 2007).

[78] Use of pattern measures the ordering of different interior architectural materials/finishes to produce complex harmonious physical structure (Rengel, 2007).

sides of the adjustable trolley. The examination adjustable trolley used for patient examination and treatment is positioned against the wall, making it difficult for two caregivers to administer care from both sides.

The DQIs used in combination with the observation protocol sheet to assess the space provision and design of the rooms were spatial organisation, openings and wall penetrations.

Spatial organisation, openings and wall penetrations: The investigation revealed that owing to lack of examination and treatment spaces and to cope with high daily patient population, A&E operational processes were changed from a broken to unbroken services delivery approach by converting all examination and treatment rooms into multi-use spaces equipped with medical gases, monitoring equipment and examination lamps. This investigation revealed that using this strategy considerably reduced the average waiting time for patients before receiving medical attention, resulting in positive outcomes in resource use efficiency, capacity efficiency and increasing average daily throughput by between 15% and 20% (Chris Hani Baragwanath Hospital, 2006).

The scores of the space organisation, openings and wall penetrations was low based on poor results obtained using these design variables: articulation; placement and circulation to evaluate space design and provision, functional suitability and spatial relationships. The design of this zone was based on open examination and treatment cubicles concept, where visual and auditory privacy is gained with curtains closure. This result agrees with the findings in the literature, the questionnaire surveys and interviews.[79] In fact, clinical intervention and verbal communication between caregivers and patients was overheard by anyone in the vicinity.

***Functional suitability**:* The space use variables explained in Chapter Four—space use occupancy level; average turnaround time and circulation; room entrance/exist counts; room

[79] See 2.9, 2.10, 3.13.2, 6.5.2 and 6.5.3.

profiles and caregivers' movement patterns—were used to analyse the functional suitability and space utilisation of Zone B. The findings are as follows:

Space use occupancy level, average turnaround time and circulation: The exploratory visits to ten A&E facilities in Johannesburg and Pretoria during the pilot study revealed that the daily occupancy levels of major and minor rooms ranged, on average, from 70% and 30% respectively. The investigation at CHBH A&E is consistent with these findings. Due to insufficient major and minor rooms at this facility, a decision was made to modify them into multi-use rooms. The additional renovation work was necessary to provide more spaces for medical emergencies (P2 patients) (see 3.11.3). Adopting the multi-use space concept reduced the average waiting time from 180 to 120 minutes for patients in wheelchairs and trolleys based on average results recorded by the researcher. This result is in line with the findings from CHBH Statistics Department (Chris Hani Baragwanath Hospital, 2006).

The findings on the time spent in rooms by the patients reveal that the average turnaround time in major cubicle spaces is between 50 to 80 minutes, excluding time spent in the A&E department before medical attention. The average turnaround time for non-emergent care patient in minor cubicle spaces is between 20 to 40 minutes. The average turnaround time excludes time spent for speciality diagnostic or in the laboratories and other ancillary areas. The above findings are similar to the data obtained by CHBH Statistics Department (Chris Hani Baragwanath Hospital, 2006).

Circulation, travel distances and interactions: Figures 6.8, 6.9 and 6.10 show the visual integration, axial mean depth[80] from the entry points and justified graphs[81] analysed respectively using observational techniques of Space Syntax. The findings reveal that the location of the circulation, supplies and equipment increases caregivers time during

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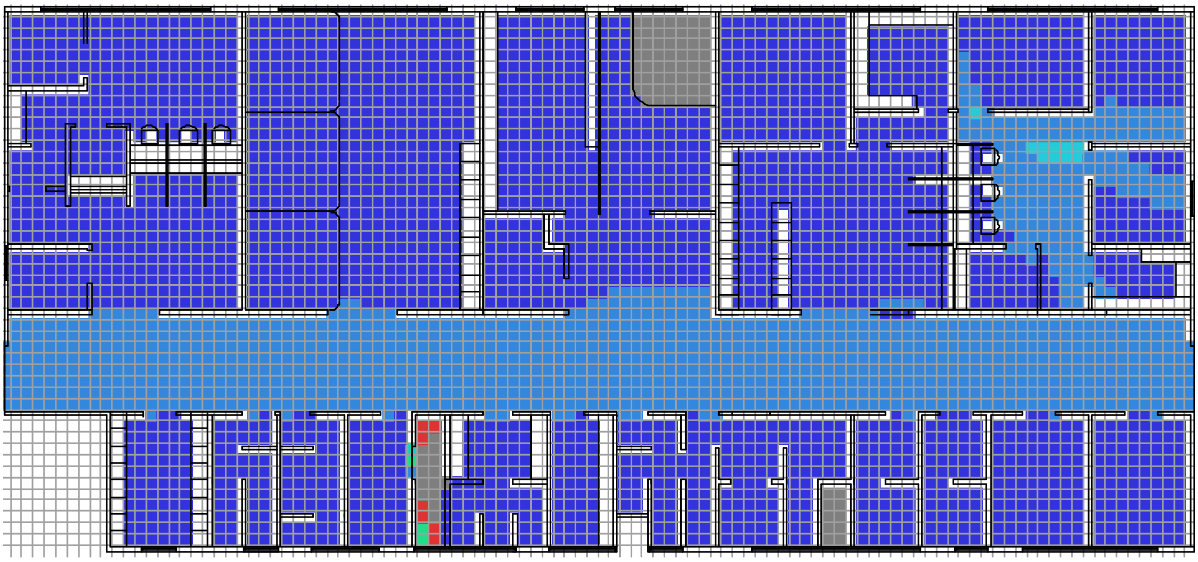
[80] Axial mean depth refers to the integration depth of the space and is derived from consideration of its depth from all points within the floor plan configuration system using visibility modelling (Hiller and Hanson, 1984).

[81] Justified permeability graph indicates how deep each space is in relation to the outside space and it is related to the degree of accessibility of each space (Hiller and Hanson, 1984).

operations due to distance travelled from the patients area to the stores and ancillary spaces. It thus also influences the degree and quality of interaction between caregivers/patients/users.



Legend

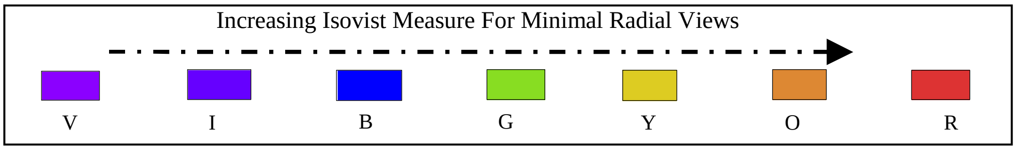


Figure 6.8: Space Syntax analysis - Visual integration

Spatial relationships and internal experience: Observational techniques of Space Syntax were used to evaluate spatial relationships and internal experience against the following DQIs: adjacency matrix; level of autonomy; internal finishes; quality of natural/artificial light and use of colour/texture; spatial relationships and interior ambience (see appendix R).

The adjacency matrix scored very low owing to the floor plan design that reflects poor arrangement of spaces according to privacy needs, degree of acoustic quality and degree of accessibility, and poor workflow processes. The results of the spatial level of autonomy were also low because of the materials used for enclosing the spaces provided. The findings inappropriate interior materials and finishes, colour scheme, and natural and artificial light; including the poor natural light levels found in some of the examination/treatment spaces.

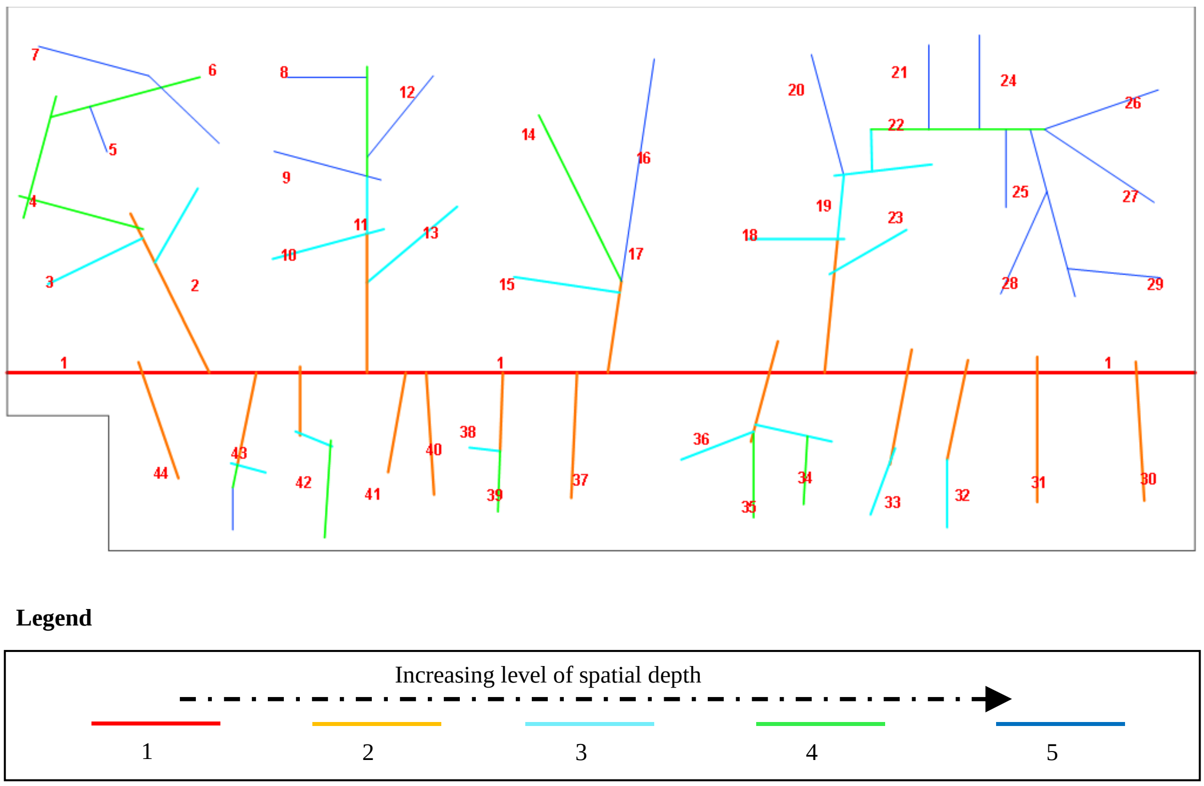


Figure 6.9: Space Syntax analysis - Axial map

6.7.3 Zone C:

Short stay inpatient areas

The DQIs used in zones A and B for space provision and design, functional suitability and utilisation, spatial relationships and internal experience were also used for the investigation in zone C. These DQIs provided information on the influence of DGAEF used for space design on behavioural cues of the users of the facility.

Space provision and design, functional suitability and utilisation: Spatial organisation, occupancy level and average turnaround time were the design quality variables used in combination with the observation protocol sheet to assess space provision and design.

Spatial organisation, occupancy level and average turnaround time: The entrance to the clinical observation spaces is located next to the nursing station; but owing to lack of space there is no entrance or wind lobby in this area. The location of the nursing station is inappropriate for observation of patients, which is important, particularly in this area. Indeed, people entering the unit through the main entrance cannot be easily seen by the caregivers.

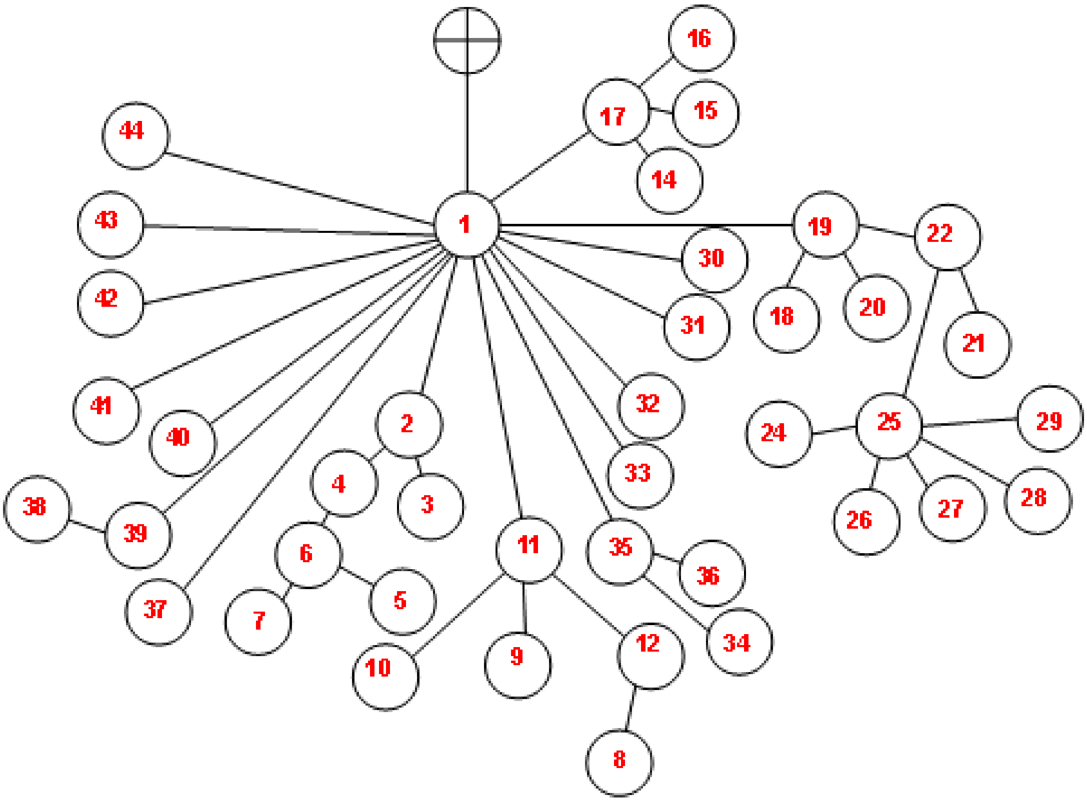


Figure 6.10: Space Syntax analysis - Justified graphs

The floor plan layout is arranged into five patient zones, each accommodating a six-bed cluster but without an en-suite facility and nurse's station. There is only one wash-hand basin for each six-bed cluster. The floor area of each patient core space in a six-bed cluster is 6.24 m^2, which is inadequate for clinical and support workflow processes. The sizes and floor to ceiling height are designed according to the DGAEF.

The overall scores for the spatial organisation were low due to the multiple-bed arrangement; non provision of en-suite ablutions; patient privacy and social support issues; lack of space for storage of equipment, supplies and monitoring of the patient. The average daily occupancy for the six-bed clusters is 65%, while the single-bed room is 75%. Observation of average turnaround time in these rooms reveals that patients remain in this space between 70 to 90 minutes.

Spatial relationships and internal experience: The spatial relationships and internal experience were evaluated using these measures (explained above): adjacency matrix; level of autonomy; internal finishes; quality of natural/artificial light and use of colour/texture.

Adjacency matrix, level of autonomy and interior ambience: The findings from the literature are that square and elliptical shapes provide more compact and integrated floor plan configurations. Compact floor plan configurations also offer better visibility of patients' rooms from nurses' stations and shorter travel distances for caregivers (Burk and Kurrasch, 2006). This study agrees with these findings, and that spatial arrangements based on desired adjacency and relationships for A&E operations should influence floor plan layouts to improve services delivery.

The overall interior finishes and materials are institutional. The walls finishes are drywall panels painted with white acrylic paint. All six-bed clusters have windows, but their design and position do not maximise daylight exposure and views to the exterior.

6.7.4 Zone D:

Support areas: (staff facilities and ancillary spaces)

The spaces provided in Zone D were evaluated using observational studies to determine the influence of the DGAEF used for the space design on the practical, physical and emotional issues relating to A&E workflow processes. The same DQIs used in zones A, B and C were used in this zone. i.e., space provision and design; functional suitability and utilisation and spatial relationships and internal experience.

Space provision, design, relationships and utilisation: The evaluation of the spaces provided in this zone provided information for establishing the criteria for user satisfaction, space functions, efficiency, easy access and flexibility. Ancillary and support areas observed were rest and recreational spaces; overnight accommodation; change rooms with associated ancillary areas; offices and storage facilities. Spatial organisation and utilisation; adjacency matrix; level of autonomy and interior ambience were also analysed using the same DQIs in combination with the observation protocol sheet discussed above. The findings provided information on the impact of DGAEF on resources use efficiency and throughput.

Spatial organisation and utilisation: There are two clusters of sanitary facilities provided inside the A&E facility, off the main corridor, for male and female patients respectively. The storage spaces (consumable store; linen store; sluice room; equipment store and kitchenette) are also located off the main corridor space. All the stores have full height powder coated steel open shelves, but there is not enough space in the stores for the heavy equipment and trolley park area.

The overall scores for choice of the spatial organisation of the staff accommodation, sanitary facilities and stores were low due to the space arrangement and location of most of the stores away from where they are needed, resulting in numerous journeys to these areas by the caregivers. These findings confirm that the space design and configuration of this zone can impact negatively on workplace performance resources use efficiency and throughput.

Adjacency matrix and level of autonomy: Figure 6.11 shows the minimum path travelled by the caregivers on daily average work shift in this A&E facility. Floor arrangement scores in zone D were poor due to spatial organisation of the floor plan. Indeed, most of the ancillary and support areas are located outside the examination/treatment and clinical decision spaces. Locating ancillary and support areas away from where they are needed results in numerous journey for caregivers during daily work shift. The observational techniques of space syntax confirm that caregivers travel to the sluice room and linen store more than 25 times and to consumable and equipment stores more than 10 times during each daily work shift.

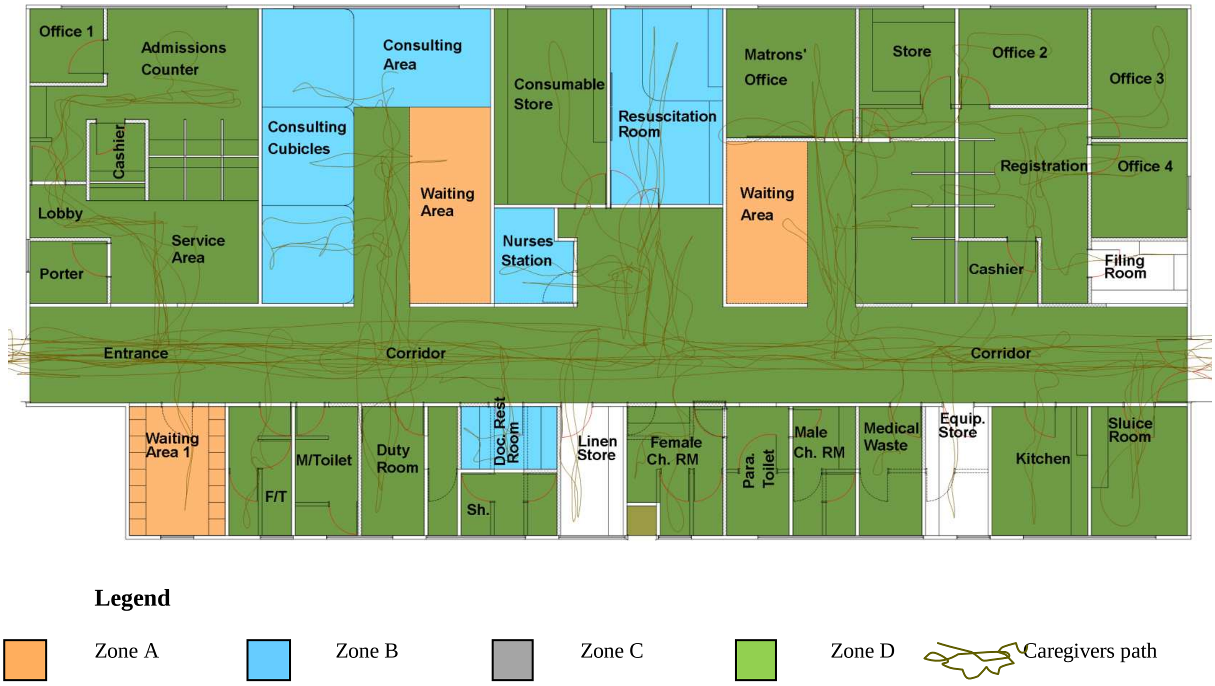


Figure 6.11: Space Syntax analysis - Minimum path travelled by caregivers

Interior ambience: The walls in this area are finished in smooth plaster with white acrylic paint, consistent with the modest colour scheme used everywhere in the unit, and the floors are finished in smooth concrete. The ceiling is suspended plaster board, providing space for double tube fluorescent lighting fittings. However, it is clearly observed that the interiors are dirty and require constant maintenance—underscoring the need for using serviceable and durable materials and finishes in this area.

6.8 The new approach to DGAEF update based on Planetree principles

The observational studies and Space Syntax techniques analysed the impact of DGAEF used for space design and provision, functional suitability and spatial relationships on the quality of the physical environment and interior ambience; as well as users' behaviours, workflow processes and their level of interaction with the physical environment. The findings were in turn analysed using the proposed model of the conceptual framework for DGAEF illustrated in Figure 2.13 and their implications evaluated.

6.8.1 The effect of DGAEF as tool for communicating project vision and objectives

The findings suggest that the components of the DGAEF that should be updated are the project brief document; design solution approach and project implementation systems.

Project brief definition: The finding agrees with information obtained from literature, survey, interviews and floor plan analysis that the main components of the project brief to be updated are: definition of project scope, space narrative, room data requirements, standard layout plans and project budget.[82]

Definition of project scope, space narrative and requirements: The analysis and findings of this chapter have focused on the impact of the DGAEF on space provision, functional suitability, utilisation and spatial relationship. The overall poor scores obtained suggest that there is need to update the project brief protocols in the DGAEF used for scope of work, functional space narratives, and space programming and requirements.

Room data requirement, standard protocols, furniture/equipment schedule and budget: The understanding of the client's requirements should improve the quality of the space design and provision, functional suitability and spatial relationships. Although, the spaces provided in this A&E comply with the DGAEF, the findings suggest that substantial improvement works should be done in order to comply with today's healthcare facilities operational space requirements. This result is supported by the findings from the questionnaire surveys, interviews and floor plan analysis.[83] Interestingly, POE has to date played little role in influencing the project development protocols and for DGAEF update.

6.8.2 The effect of DGAEF on effective and efficient A&E facilities

The findings suggest the need to obtain comparative information relating to the project before commencing the design process. They are in line with the findings from the literature, questionnaire surveys, interviews and floor plan analysis on the importance of defining the

[82] See Chapter Two: 2.9 and 2.10; Chapter Three: 3.13; Chapter Five: 5.3 and 5.4; and Chapter Six: 6.3, 6.4 and 6.6..

[83] See Chapter Five: 5.3 and 5.4; Chapter Six: 6.3, 6.4 and 6.6.

DQIs for evaluating these components of the design solution: space planning; design development; adaptable and flexible spaces and technical documentation.[84]

Design development, space planning, interior finishes and technical documentation: The study found that the design of a space has more to offer than function, technical performance and impact or perception. The findings of the study support this view based on the hard evidence gathered from this investigation since the key component of design is the: project brief document.

The lack of sufficient information in the DGAEF for evaluating these design components: space planning, design development, interior finishes and technical documentation are identified as among the key issues that need solutions obtained through research. The findings suggest the need to translate the project brief into a collection of spaces subdivided in special ways in response to their optimal relationships: form, materials and finishes. And also of using research based information obtained from POE in order to ensure and maintain the interrelationships and interdependencies of these spaces.

The findings also suggest the need to obtain comparative information on the project type through a strategic project briefing document before commencing the project development process. This argument is in line with the literature, questionnaire surveys, interviews and floor plan analysis.[85]

Space planning, design development and technical documentation: The results show that the general and specific design requirements in the DGAEF provide limited information systems that cannot adequately address the current challenges and problems in A&E facilities environments during project briefing, design, construction and operations. This suggests that there is need for KPIs in the DGAEF for evaluation of space planning, design requirements, design development and technical documentation; and for defining criteria for POE processes

[84] See Chapter Two: 2.9 and 2.10; Chapter Three: 3.13; Chapter Five: 5.3 and 5.4; and Chapter Six: 6.3, 6.4 and 6.6.

[85] See 2.8, 2.9, 3.13, 5.3, 5.4, 6.3, 6.4 and 6.6.

in the DGAEF update. These findings are consistent with the issues that emerged in the literature review, questionnaire surveys, interviews and floor plan analysis.[86]

6.8.3 The importance of the users participation in project development process

The information provided by healthcare facility planners and caregivers are mainly concerned about healthcare system and personal requirements, rather than the challenges and problems constraining the design of an improved physical environment. The findings from this study show that the information obtained during project briefing excludes the needs of the community and the caregivers. Indeed, the floor plan arrangement and interior ambience raised questions about the appropriateness of the space design and provision to be able to handle the daily patient attendance and workflow process requirements of the A&E facility. These findings are in line with those from the literature, questionnaire surveys, interviews and floor plan analysis.[87]

Suitability of spaces, comfort and sustainability: The findings show that the caregivers were not adequately consulted during design of the entrance, waiting, registration and triage area in this A&E facility as their participation in the design should have led to a different floor plan configuration. Thus, the completed facility now requires considerable improvement to achieve improved measurable outcome on daily workflow processes in zones A, B, C and D, in order to improve the facility resources use efficiency, capacity efficiency and also throughput. These findings agree with results of the interviews and floor plan analysis.[88]

6.8.4 The effect of DGAEF on technology innovation and updates

The findings favours the use of technology innovation for optimal integration of: spatial organisation with the engineering services; design solutions of the floor plan layout with A&E operations; the quality of the materials and finishes with technical performance.

[86] See 2.9, 2.10, 3.13, 5.3, 5.4, 6.3, 6.4 and 6.6.
[87] See 2.9, 2.10; 3.15, 5.3, 5.4, 6.3, 6.4 and 6.6.
[88] See 6.3, 6.4 and 6.6.

Designing integrated spaces with engineering services for multiple uses: The findings reveal that it is essential for the design team to obtain comparative information through the use of technology for: estimating workload prediction; desired operational systems and engineering services required in each A&E spaces. Obtaining this information early preferably through the use of technology innovation during project briefing can positively influence the floor configuration, spatial relationships and their integration with engineering services.[89] The findings further reveal that understanding the operational system and services required in each space is essential to influence the design team to provide integrated and comprehensive design solutions for the A&E operational spaces—which should also encourage the design of integrated and flexible spaces. The empirical information obtained in CHBH A&E facility shows that the design of integrated multiple use spaces can improve A&E resources use, capacity efficiency and throughput.

The results of the investigation shows that the increase in capacity efficiency occurred in this facility were partly attributable to the use of current A&E spaces as universal examination/treatment spaces thereby supporting the concept of unbroken sequence of medical attention. Even though the available spaces were not designed to support the integrated universal space design concept, the unbroken sequence of healthcare services delivery strategy was used in the available spaces due to operational issues and to fast track medical attention to patients.[90]

These findings also suggest that the introduction of KPIs in the DGAEF update for the use of technology innovation is important due changes that occur over time.

6.8.5 The role of DGAEF on institutional transformation and operational systems

The findings affirm that the management and efficiency of any process rely on the characteristics of the key actors, the operating environment, the institution, communication

[89] See 2.9.5, 3.12.3, 6.6.4.
[90] See 5.4.4 and 6.4.4.

strategies, information systems and the quantity and quality of relationships and social interactions. These findings are consistent with those from the literature, surveys, interviews and floor plan analysis.[91] These findings point to the importance of the development of strategies to continuously innovate the DGAEF taking into cognisance the following issues in particular: contract documentation; communication; and management of the project development process.

Contract documentation, communication and management of the project implementation process: The findings reveal positive measurable outcomes of the construction management approach used for the project development process of the CHBH A&E facility. The empirical information gathered shows that the facility was completed within the programmed completion date and within project budget. Indeed, this was the first time that Gauteng Department of Public Works was able to complete a healthcare facility project on time and within approved project cost. Furthermore, this investigation revealed the need to develop contract documentation and project development guidelines considering the guidelines used for this A&E facility for the update of the DGAEF.

The finding suggest the need to provide KPIs for evaluating and measuring project development communication and management processes.[92] The above findings also suggest the need for the integration of design and construction in one process through the DGAEF used for the project development process.

6.8.6 The importance of DGAEF on standardisation of the project development process and life-cycle costing

The results of the observational studies suggest that good DGAEF can positively influence the quality of physical environment. Indeed, this investigation demonstrates a direct

[91] See 2.10. 4, 3.13.1, 5.4.4, 5.4.5, 6.3.3 and 6.6.5.

[92] See 2.10.5, 5.3.5, 6.4.4 and 6.6.6.

relationship between the DGAEF used for the design of this facility and the quality of the physical environment;, quality of services delivery and level of satisfaction .

Quality of the product, quality of services delivery and level of satisfaction: Generally, the role of DGAEF for space design and provision should focus primarily on fulfilling current project development needs in order to address the huge backlog in A&E facilities in most communities in South Africa. In this regard, the findings suggest the need to introduce generic standardised project development tools owing to the positive outcomes obtained using the same for this A&E facility. The findings also favour the use of standard design tools to encourage innovation in the project development process, improvement of quality of the A&E facilities and long project development programme, aesthetics and the level of satisfaction of the users. These findings agree with the literature, questionnaire surveys and interviews that providing more flexible general and specific design requirements in the project development documents can provide opportunities for developing standardised project briefing documents, design solutions and project development processes.[93]

The findings are consistent with the argument in the literature that standard project development tools in the DGAEF can offer ample choice for effective and efficient use of resources; improved flexibility in operational systems; and integration and coordination of the design, construction and operation and maintenance processes.[94] Furthermore, standardised project development tools have an added advantage of being able to break up complex projects, such as A&E facilities into more manageable phases which can be merged in future based on operational requirements and life-cycle costing perspectives. This suggests the need to use standard project development protocols and promote a "design and operation systems based perspective" for the development of A&E facilities.

[93] See 2.10.5, 5.3.5, 6.4.4 and 6.6.6.

[94] See 2.10.5, 5.3.5, 6.4.4 and 6.6.6.

6.9 Summary

Section A: descriptively analysed the information and opinions provided by the different stakeholder groups on the key themes identified in the literature and the study—design tools; quality of the physical environment; perceptions or impact (see 2.14).

The issues pertinent to the update of the DGAEF discussed in this section are awareness, use and compliance to the DGAEF; impact of DGAEF on achievement of healthcare facility development goals; inappropriate DGAEF and healthcare institution organisational culture; space design and quality of services delivery; and standardisation of project development processes and technology innovation.

The interview findings also provided essential information on the following issues pertinent to update of the DGAEF based on Planetree principles: the influence of DGAEF on healthcare facilities and community; the vital role of participatory processes; introduction of DQIs for universal rooms design; the influence of DGAEF on technology innovation, space design and operational systems; introduction of comparative measures to improve project development process. Table 6.2 summarises the respondents' views on obstacles, environmental issues and themes that can influence the DGAEF update.

Table 6.2: Interview participants views on obstacles, environmental issues and themes that can influence the update of DGAEF

Identified problems	Environmental design issues	DGAEF themes
Inadequate project briefing document	Provision of adequate functional and operational spaces	Design tools/ Quality of the physical environment/ Institutional Culture
Poor systems for defining general and specific design requirements	Informed floor plan configuration and interior ambience based on data obtained through research	Design tools/ Space functions/ Operational organisation
Lack of comparative data for workload prediction and space provision	Improved floor layout design, room sizes and built form	Design tools/Perception/Ambience
Insufficient standardisation of design, construction and POE protocol systems	Facilitate the design of improved spaces and physical environment	Design tools/ Perception/ Social integration
Insufficient use of technology for design, construction and in operational systems	Ease of project development process and operational systems	Quality of the physical environment/ Institutional culture
Lack of DQIs to influence positively design and construction timeframes and also project costs	Provision of adequate healthcare facilities within project development process timeframe and budget	Design tools/ Quality of the physical environment/ Social integration

The first part of Section B explored the influence of the DGAEF on space design and provision, space utilisation, functional suitability and spatial relationships based on the A&E operational requirements using HTA, LA and Space Syntax techniques. And the second part of this section evaluated the floor plans configuration based on Planetree principles. The findings underscore the need to introduce DQIs and KPIs in the DGAEF update for the evaluation of the outcomes of the overall project development process. The limitations, challenges and gaps in the DGAEF are also highlighted.

The findings have been presented according to the thematic categories identified in the literature review and the conceptual frameworks summarised in Figures 2.7 and 2.8. The challenges that emerged from the results of the floor plan analysis at CHBH A&E facilities and the identified design issues and the themes that can influence DGAEF update are summarised in Table 6.3.

The first part of Section C described the influence of the DGAEF on the quality of the physical environment and interior ambience in Zones A, B, C, and D using observational studies and Space Syntax techniques. Additionally, the second part of this section analysed the physical environment and interior ambience based on Planetree principles. The results of this study suggests that the quality of the physical environment may be related to the DGAEF used for the healthcare facility project development process.

This study identified gaps in the DGAEF and provided important information on ways of addressing problems and challenges related to: social; economic and environmental issues. The gaps identified and the categories of the themes that can influence DGAEF update are illustrated in Table 6.3.

Table 6.3: Summary of the challenges that emerged from the results of the floor plan analysis at CHBH: identified design issues and themes that should influence DGAEF review

Identified design issues	DGAEF themes
Zone A **Design improvements are required in these areas:** • Registration area inadequate • Poor surveillance of the waiting area • No space for triage • Waiting area inadequate	• Design tools • Quality of the physical environment • Perception • Ambience • Institutional Culture • Socio-economic integration
Zone B **Universal rooms concept can improve these issues:** • Open cubicles design arrangements is considered obsolete • Need for flexible and adaptable spaces • Poor patient and visitors surveillance • Patient safety issues (transfers and wash hand basins) • Space constraints for the needed social spaces	• Design tools • Quality of the physical environment • Perception • Ambience • Institutional Culture • Socio-economic integration
Zone C **Multi-use spaces can improve outcomes:** • Need for flexible and adaptable spaces • Poor patient and visitors surveillance • Restricted movement during operations • Lack of family spaces in the rooms	• Design tools • Quality of the physical environment • Perception • Ambience • Institutional Culture • Socio-economic integration
Zone D **Interdisciplinary project team can improve design outcomes:** • Staff facilities inadequate • Ablution facilities sizes inadequate • Location of storage effects operations • Long travel distances	• Design tools • Quality of the physical environment • Perception • Ambience • Institutional Culture • Socio-economic integration

The findings of the case study of CHBH A&E facility using a combination of qualitative and quantitative methodologies provide empirical evidence on the importance of DGAEF for space design and provision of A&E facilities projects. Indeed, the results of the interviews, floor plan analyses, and observational studies and Space Syntax techniques suggest that the quality of the physical environment may be directly related to the DGAEF used for the A&E facility project development process.

This case study also identified inadequacies in the DGAEF and suggested ways of addressing them. The gaps identified and the categories of the themes that should influence DGAEF update are summarised in Table 6.4.

Table 6.4: Identified gaps, social, economic and environmental issues and themes that should influence DGAEF

Identified gaps in the DGAEF	Social/economic/environmental issues	DGAEF themes
Inaccurate design information	Acknowledge the need for future change	Design tools/ Quality of the physical environment/ Institutional Culture
Space narrative and room data requirements	Involvement of users can reduce costs and improve space use	Design tools/ Quality of the physical environment
Spatial organisation and space zoning (adjacency matrix)	Encourage social inclusion and life-cycle costing and maintenance	Design tools/ Perception/Ambience
Space constraints	Enable the introduction of social spaces and interaction	Design tools/ Perception/ Social integration
Lack of information to encourage the design social model of care	Improve awareness and health gain by the community	Quality of the physical environment/Institutional culture
Lack of design quality measures	Preserve and enhance value systems and cost	Design tools/Perception
Procurements approach	Facilitate the delivery of the healthcare facilities to the community	Design tools/Perception
Quality of the patient/staff/visitors' experience	Improve community attachment to the facility, accessibility and equity	Quality of the physical environment/ Social integration/Value system

7 CHAPTER SEVEN

DGAEF IN PRACTICE: CASE STUDY OF PRETORIA ACADEMIC HOSPITAL

7.1 Introduction

This chapter presents the findings and analysis of the interviews, floor plan analysis and observational studies carried out at Pretoria Academic Hospital (PAH) A&E facility. The findings are analysed within the framework of the thematic categories identified in Chapter Two—design tools, quality of the physical environment and perception, and are also compared with findings from similar studies. This chapter comprises three main sections:

Section A presents the results of the interviews and contains three main parts. The first summarises the respondents profiles; the second presents the respondents' views on the DGAEF; and the third discusses the structure of the DGAEF and an approach to their update based on Planetree principles (see 2.7).

Section B discusses the results of the floor plan analysis and is divided into two sections. The first discusses space functions and the criteria for floor plan evaluation, and the identified challenges relating to the DGAEF used for space design and provision. The second explores the implications of the DGAEF update based on the Planetree principles.

Section C discusses the results of the observational studies and Space Syntax techniques. It comprises two parts: the first describes the influence of the DGAEF on the quality of the physical environment and interior ambience; and the second explores the implications of DGAEF based on the Planetree principles.

The chapter ends with an overview and tabulated summary of the emerging issues.

A. RESULTS OF THE INTERVIEWS

7.2 Respondents' profile

The interview participants were fifteen males (15) and eight (08) females, selected using purposive sampling.[95] The consultant category included architects, civil/structural engineers and quantity surveyors; and the caregiver's category physicians, nurses and clinical managers. Gauteng Government staff interviewed included directors, senior and junior staff. Selection of participants in the patients/community members category was based on educational background, Respondents were aged between 25 and 66 years and above as shown in Table 7.1.

The participants provided valuable insights, observations and recommendations. The consultants readily participated in the hope that the information they provided would be used to update the DGAEF. The caregivers, being among the main users of the facility, were likewise eager to participate. The government officials took part because of their keeness to see the challenge of DGAEF which are not suitable to the local context, epidemiology, service expectations and available resources addressed.

Table 7.1:Profile of the respondents

	Consultants						**Caregivers**						**Government**						**Patients**						**Total**
	Architects A1, A2, A3		**Civil/Structural Engineers CS1**		**Quantity Surveyors QS1**		**Physicians PH1**		**F/nurses FN1, FN2, FN3**		**Clinical managers CM1**		**Directors D1**		**Senior staff SS1, SS2, SS3**		**Junior staff JS1, JS2**		**Sec. School PS1, PS2**		**Diploma PD1, PD2**		**University Degree PU1, PU2**		
Gender	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	
25-35 years										1										1	1			1	**4**
36-45 years							1			1							1						1		**4**
46-55 years		1					1			1	1		1		1	1		1	1		1				**10**
56-65 years	1				1										1										**3**
66 & above	1		1																						**2**
Total	**2**	**1**	**1**	**0**	**1**	**0**	**2**	**0**	**0**	**3**	**1**	**0**	**1**	**0**	**2**	**1**	**1**	**1**	**1**	**1**	**2**	**0**	**1**	**1**	**23**

[95] See Chapter Four, section 4.6.3. The number and gender composition of the interview participants used for the PAH case study was similar to that for the CHBH case study to facilitate comparison.; but the participants were different.

7.3 Participants views on the DGAEF

The participants identified a number of issues related to the DGAEF as constraints to improved design of A&E facilities, including: awareness, use of and compliance with the DGAEF; the influence of DGAEF in achieving healthcare facility development goals; inappropriate DGAEF; lack of evaluation criteria and KPIs; and standardisation, customisation and technological innovation in the project development process.

7.3.1 Awareness, use of and compliance to the DGAEF

Those involved in formulating DGAEF have become so focused in implementation, according to A1, that they are not interacting with the key actors as necessary to raise awareness. Hence the main objectives of use of the DGAEF are being overlooked to the disadvantage of healthcare services delivery.

Some consultants view the DGAEF as a means of controlling capital expenditure and limiting the overall size of the building; while others see them as a burden in an already complex field owing to limited research and inadequate information systems. All these factors influence the level of compliance (A3 and D1).

7.3.2 Influence of DGAEF in achieving healthcare facility development goals

The design processes for a new facility, A1 asserts, offers a unique opportunity for healthcare institutions to assess their performance, and to change the existing institutional culture and redesign workflow processes. As one of the caregivers comments (FN1):

> *"The caregivers workflow process and operations are better in this facility than the old one. However, the space design and provisions, functional suitability and spatial relationships are inadequate and the overall floor plan configurations are still not according to patient/staff/visitors centred care facility principles."*

DGAEF have a significant role to play in informing the design development and construction approach, as well as in improving the workplace environment (D1 and SS1). It is important, therefore, to provide information systems on institutional culture during briefing, design development and construction processes; and integration of these activities can be managed through the DGAEF update (A1). Indeed, improvement of healthcare facilities to bring about transformative change should positively impact on the quality of patients and caregivers experiences (A1, D1 and SS1).

7.3.3 Effects of inappropriate DGAEF on the healthcare institution

Since 1983 when a team of consultants was first appointed to design the new A&E facility for the 1,200 bed PAH on the existing site, the design brief has been revisited on several occasions (D1). The numerous changes resulted in an inordinately long project development timeframe—from project brief to commissioning took nearly 30 years (A1).

One of the key factors that influenced the introduction of the DGAEF in the 1970s, A1 affirms, was the need to be able to more accurately the project cost. This objective was not met in this project. The inconsistencies in the project brief given to the design team led to various suspensions of the project during design and construction phases. The many changes in the project brief escalated the construction cost from the original budget of USD 50 million to the current USD 100 million. Another factor that led to the long construction period and budget escalation is the multiple procurement strategy adopted for the construction of the building. The main contract was unbundled into several small contracts to enable the involvement of previously disadvantaged individuals and firms (QS1).

The importance of a comprehensive briefing document to improve design quality and timeframe for the delivery of A&E facilities was underscored by the respondents. Most suggested the introduction of flexible and adaptable standardised project briefing tools that can be adjusted according to particular needs and contexts for all categories of healthcare facilities. This will also help ensure that the vision and culture of the healthcare institution are maintained and transformed based on the new trends in the field (A3 and D1).

7.3.4 Introduction of DQIs for designing healthcare facilities

The use of research to develop DQIs for the project development process is, in the view of JS1, important in making decisions on desirable space design and provision that will influence caregivers workflow processes. Using research for developing DQIs can provide comparative information systems that will encourage innovation in design solutions for healthcare facilities projects (A3). Thus, introducing DQIs for floor plan design in the DGAEF update is key to improving the quality of the A&E spaces and workflow processes.

The architects are of the opinion that the current floor plan configuration for this facility requires major alteration works to improve the adjacencies and proximities between spaces (A1, A2 and A3). But A3 cautions that future design modification may not be easy due to budget constraints.

The caregivers criticised the inadequate space provided in the PAH A&E facility (FN1, FN2 and FN3); and are of the opinion that the most important space in modern A&E facilities is the "fast track" area. According to FN3, the fast track area should be a technology-driven environment and facilitate easy assessment and treatment of non-urgent cases, thereby reducing overcrowding and improving A&E capacity efficiency. .

Indeed, there is growing consensus amongst stakeholders on the need to introduce KPIs in the DGAEF update for evaluation of the design solutions for A&E facilities to ensure their efficient and effective development. These emerging issues are consistent with the findings from the literature, survey and interviews.[96]

7.3.5 Standardisation and technological innovation

According to the caregivers, the design of the PAH A&E facility could have provided a better physical environment if standard project development information systems were used during project development of this facility (FN1, FN2 and FN3). In fact, the scores for KPIs

[96] See Chapter Two: 2.5 and 2.6; Chapter Three: 3.15; Chapter Five: 5.4.4 and Chapter Six: 6.3.4.

in the design and construction of this project—time, budget and quality of the finished product—were poor (A3 and D1).

Translation and adaptation of technology should be used to evaluate design information such as workload predictions, computer modelling, mock-ups and walk-through simulation (A3 and D1). Using technology during the design process reduces the risks associated with clients not understanding what is contained in the design related documents, which commonly results in delayed approval of technical documentation (A3). Introducing information systems for the use of technology in the DGAEF update can, in the opinion of some respondents, address these issues: quick registration procedures to get patients through the system; streamlining of patient pathways through provision of adequate triage spaces; and designing for future growth (PH1 and FN3).

7.4 Participants' views on DGAEF update based on Planetree principles

The interviews highlighted the following issues as needing to be addressed in the DGAEF update: the vital role of DGAEF in healthcare facility development; participatory design solutions and implementation; use of an integrated design approach; use of technology for space design and provision; and research-informed institutional transformation.

7.4.1 Influence of DGAEF on healthcare facilities and social support spaces

The interview results provided valuable information relating to caregivers/patients/visitors levels of interaction with physical environmental variables—such as changes in temperature, light, sound, location, dimensions, distances, materials, furnishing and the equipment used in the care setting—that influence the level of satisfaction and experiences of users and the quality of healthcare services delivery.

The influence of the physical environment on the quality of services delivery: The interview data and information collected routinely from the caregivers revealed that patients/staff/visitors are not overwhelmed by the design of the PAH A&E facility. The main reason being, according to PH1 and FN3, the poor spatial arrangement of the floor layout. This, together with the lack of social support areas, have contributed to the low scores on user satisfaction and experience of the users and poor quality of healthcare services delivery (A3). Improved design of the patient/staff areas should provide spaces to support effective and efficient social interaction amongst users (A1).

The role of DGAEF in social support spaces and quality of services delivery: There is need for the introduction of HTA, LA, Space Syntax techniques and design software programmes such as AutoCAD to collect and analyse a broad range of information about the space design and floor plan configuration (A1). Today's focus on space programming and spatial arrangements, with little attention paid to tools for design development, limits the ability of stakeholders with lesser design skills to effectively communicate and contribute during the project development process (A1). Indeed, lack of comprehensive information systems in the DGAEF has influenced inadequate space provision, especially of social support spaces (A2).

To improve the physical environment and quality of services delivery, respondents suggest the introduction of breakaway spaces within the A&E unit; use of universal examination/treatment rooms to allow for the presence of family members/visitors; provision of a resource centre/library; and quality children waiting and play areas.

7.4.2 Design solutions and project development process through participation

The update of DGAEF involves, in the opinion of respondents, searching for current best practices based on comparative evidence from relevant Government departments, professional organisations, caregivers, social services organisation, academics and the community. In addition, the involvement of the broader community is essential during the development of any policy issues especially if patient/staff/visitors centred principles are to be considered in the DGAEF update.

The importance of patient/staff/visitors centred design approach: A participative approach to decision-making role is the most effective way to tap work-force/community knowledge (D1 and SS1). This approach is still little used in developing countries, especially in sub-Saharan African; but it is gaining in recognition in South Africa since the demise of the apartheid system (A1 and A2). The introduction of policies that can improve patient satisfaction and experience is important, based on providing general and specific design requirements relating to these issues in the DGAEF used for healthcare facility development (D1). As most patients are accompanied by one or more persons to the A&E facility, their involvement in any decision-making process is important (PH1).

Healthcare spaces and furniture/equipment requirements: The design team involved in the PAH A&E facility project revealed that too many late decisions and variations from the administrative and clinical staff led to frequent design changes and consequent increase in the overall project cost (A3). Hence the need to involve all healthcare institution staff, including the housekeeping staff, as they can provide invaluable insights into various aspects of the design (FN2). The views of the staff are especially important in designing the floor plan configuration and interior materials and finishes (FN1). Structured decision-making tools, such as SWOT analysis, HTA, LA, Space Syntax and CAD programmes such as AutoCAD, should also be introduced in the DGAEF update (A1, A2 and A3).

7.4.3 Defining KPIs for the use of integrated design approach in the DGAEF

The findings suggest that the stated goals of the DGAEF have not been met based on the design tools and construction system used for the project development process of the PAH A&E facility. D1 and A3 observe that the floor plan arrangement of the PAH A&E facility constrains efficient and effective use of resources, and limits capacity efficiency and throughput. There is thus need to introduce KPIs to guide the use of an integrated approach to project design and development in the DGAEF update (QS1 and D1).

The importance of physical environment in improving A&E operations: The use of an integrated approach to improve the A&E facility physical environment should be based on comparative data obtained through POE and an understanding of the users' experience (A3). The knowledge gained should be analysed using the key components of the environment of care (EOC), namely: design concepts; people; systems; floor layout configurations; A&E operation systems; physical environment and project development process (A3). An integrated design approach should optimise current space utilisation and also provide flexible and adaptable spaces (SS1). This approach should be informed by the introduction of general and specific design requirements in the DGAEF update.

Universal rooms and the need for speciality unit in A&E facility: Most of the interview respondents are for the introduction of universal patient rooms. They suggest the need to develop DQIs for improved space design and provision to address the following issues: provision of social support spaces; privacy and dignity; improved levels of satisfaction; and stress reduction for the caregivers. On the question of introducing speciality units in this facility, A2 and A3 indicate that there are speciality spaces provided for: obstetrics/ gynaecology; paediatric, psychiatric, ENT and ophthalmology. However, the interviews results question the floor plan configurations of the speciality spaces and quality of the spaces provided; thus favouring the introduction of universal rooms in the DGAEF update.

7.4.4 New approach DGAEF update using technology innovation

The interviews results support the view in the literature that healthcare facilities are amongst the most complex buildings to design as life and death decisions are made within this setting. Only recently has the need to collect more comparative information before designing these buildings become a more widely accepted design approach (A1and D1). However, to date, hard evidence gathered through research, literature reviews and POE has played an insignificant role in the project development process of A&E facilities and for the DGAEF update, especially, in South Africa (A3).

Space planning, functional suitability, relationships and interior ambience: The different stakeholder groups recognise that there is a range of analytical methods available to help improve the performance and efficiency of healthcare facilities design. Design tools such as POE and technology innovation should assist in providing comparative solutions to space design and provision; functional suitability and space utilisation and spatial relationships and internal experience (A2 and JS1). Technology innovation and POE should encourage the implementation of the project vision and objectives as set out in the project brief and ensure that they are achieved to the highest standard (A1 and JS1).

The role of POE in space design and provision: According to A3, the data collected from POE of this facility currently influences the culture of the design process in his practice. There is a need to establish a culture of learning through development of POE procedures for efficient and effective communication and continuous feedback. KPIs should be used to identify good design examples and design failures based on hard evidence. The information gathered from this method should be used for continuous update of the DGAEF (A1 and A3).

7.4.5 Defining research based measures for institutional transformation and change

The design process for any building is characterised by definition of the design problem and strategy for project development process. As noted above (see 7.3.2), the project brief for PAH A&E changed frequently owing to the inadequate design information provided to the consultants. This suggests the need to introduce research-based guidance for defining the design briefing process; the quality of the physical environment and the desired culture/value systems of the healthcare institution.

Defining a new approach to update of the DGAEF: The development of a good project brief should provide information systems for the integration of an interdisciplinary design team (A3 and D1). A good design brief should also address the following architectural conceptual issues, which are functional requisites or imperatives: space requirements, context, scale, integration and harmony; architectural aspiration (social and symbolic components; improved environment; aesthetic; healing and comfortable spaces); architectural expressions (space configurations, building form, interior/exterior materials and finishes, quality of natural and artificial lighting, and the use of colour and textures) (A1 and A3).

Identified solutions for DGAEF update: The respondents suggest that the concepts of adaptability, obligation, reward and competition be introduced in the DGAEF update as they can improve the three key design variables of function, technical performance and perception. Additional measures recommended are updating of the design tools for space design and provision of clinical, nursing and support/ancillary areas; updating of the technical performance components in the design tools for improving the quality of the external/internal materials; and updating of the design variables influencing perception in the design tools to improve user satisfaction and quality of services. The introduction of these concepts can improve the design of A&E spaces, thereby, achieving positive measurable outcomes in: social, economic, cultural and political issues within the healthcare institution.[97]

B. RESULTS OF THE FLOOR PLAN ANALYSIS

The effect of the DGAEF and floor plan layout of the PAH A&E facility was comprehensively explored using: HTA, LA and Space Syntax techniques, which were explained in detail in Chapter Four (see 4.7.1 and Appendix P).

As in the case of the CHBH A&E facility in the preceding chapter (see 6.3), the floor plan of the PAH A&E facility was categorised into four functional zones as shown in

[97] See Chapter Three: 3.2, 3.3, 3.4, 3.5, 3.6 and 3.7.

Figure 7.1: Zone A (entrances, waiting, triage and pre-examination); Zone B (examination and treatment areas); Zone C (inpatient areas); Zone D (support areas: administration, pharmacy, staff areas and visitors areas).

Legend

ZONE A ZONE B ZONE C ZONE D

Figure 7.1: Pretoria Academic Hospital A&E facility - Floor plan layout

7.5 The effect of DGAEF on space design and provision

Floor plan analysis was used to gain knowledge on the effect of the DGAEF on space design and provision. The following DQIs were thus used to evaluate the floor configurations: space provision/design; functional suitability/utilisation and space relationships.

7.5.1 ZONE A

Entrances, reception/ waiting, and triage/pre-examination areas

Arrival and entrance: There are a total of six (6) entrances to the PAH A&E unit. The two main entrances are for ambulance and ambulatory patients respectively. The other four entrances, two of which are located opposite the main entrances and the other two off the main corridor, lead to adjacent hospital departments. The security office is located opposite the porter's office and the ambulance entrance, but no space is provided to search people for firearms or other weapons. This is considered an essential space in A&E units in South Africa to control firearms and gang activities within these facilities. There is also no space within the entrance area for patients/visitors to put their belongings.

Reception and waiting: The reception and admissions, which are located next to the ambulance entrance, comprise four cubicles: one primarily for the A&E unit cashier and the other three for information/admission functions.

There are three waiting areas: one is located inside the main entrance area, while the other two—one for patients waiting for consultation and the other a children's waiting with play area—are located off the main hospital corridor. The adult waiting area is appropriately located, but the space provided is insufficient for the daily average of 220 patients, excluding visitors. The location of the children waiting close to the ambulatory main entrance and the general ablutions facilities is poor.

Triage and pre-examination areas: These spaces are located at the main entrance close to the trolley park area limiting visibility and surveillance from the reception and admission counters. The space design has influenced the negative outcomes of the quality of spatial arrangement and experience of users of these spaces. For example, the location of the triage and pre-examination spaces should enable staff to observe and control access to the treatment areas.

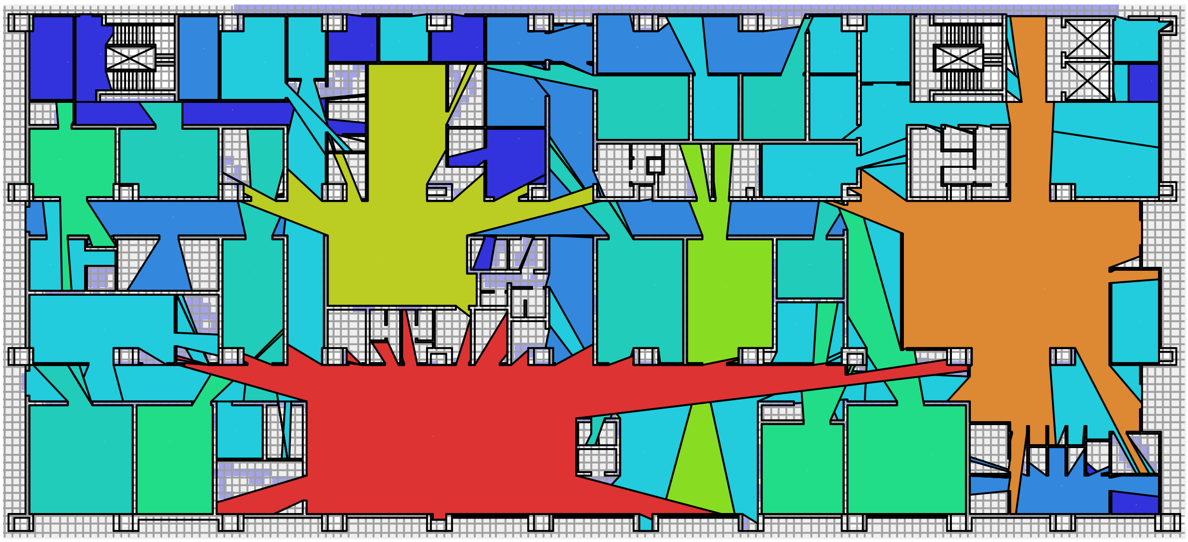
Space design and provision: Space organisation and openings/penetrations are important elements of space provision and design. The DQIs used to assess these elements were the following: access control; wayfinding and surveillance of the waiting area/rooms to determine the quality of the physical environment.

Space organisation and openings/penetrations: The design configuration and location of the entrances is important from the perspectives of both patients and caregivers. The visibility graph analysis done using Space Syntax isovist measures[98] in Figure 7.2 reveals that

[98] See 6.5.1

the ambulatory patients and recumbent patients' entrance are adjacent to one another. Therefore on average of 33% of the ambulatory patients uses the recumbent patient entrance.

The results of the visibility graph analysis show that the Space Syntax isovist measures in this zone vary from as little as 10% in areas within the entrance to as much as 95% in the children's waiting area. The wayfinding indicator applied in this zone confirms that the reception and admission counter are not directly visible from the ambulatory patients' entrance. The visual connectivity analysis in Figure 7.3 supports these findings, underscoring that the floor plan configuration should improve efficiency by streamlining arrival pathways and separating patients according to their priority of care.



Legend

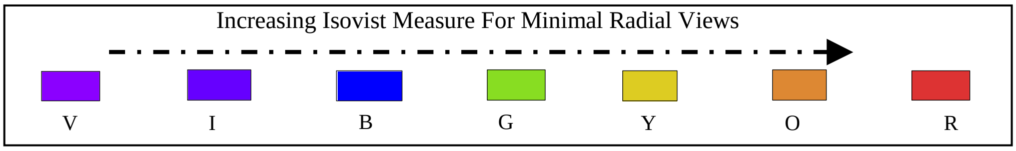


Figure 7.2:Space syntax analysis - Isovist measures

Functional suitability, utilisation and spatial relationships: The design variables analysed to assess functional suitability, utilisation and spatial relationships in this zone are: circulation; adjacency matrix and level of spatial autonomy (which determines patient privacy in the triage/pre-examination areas).

Circulation, adjacency matrix and level of spatial autonomy: Circulation spaces account for over 30% of the overall area in zone A. The main users of this space are visitors (51%) followed by patients (44%). Caregivers are by far the minority users (4%), primarily because there are no staff stations within zone A.

The analysis of functional space adjacencies and level of spatial autonomy in this zone using HTA and LA revealed the following: long travel distances from children waiting to the ablutions facilities; and poor degree of privacy and dignity within triage/pre-examination area.

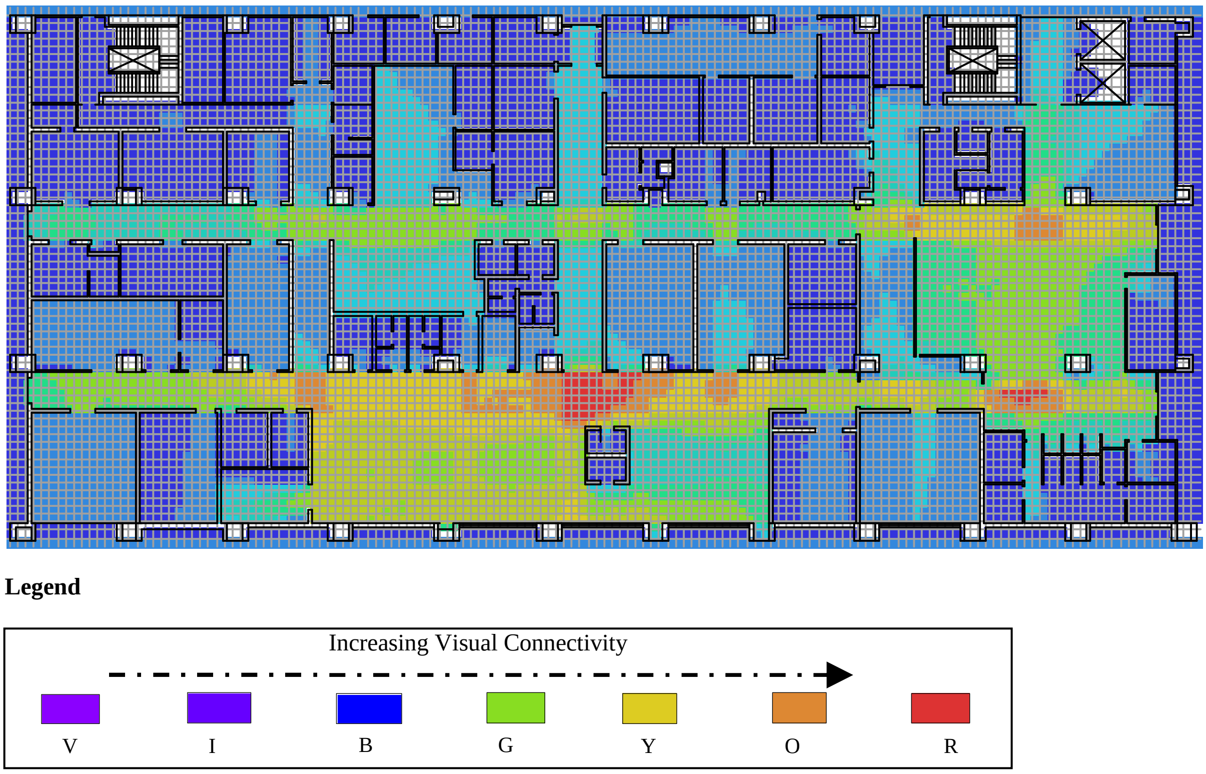


Figure 7.3: Space syntax analysis - Visual connectivity

7.5.2 ZONE B

Examination and treatment areas

PAH A&E unit attends to 220 patients daily, treating various medical and surgical emergencies (PAH, 2006). The floor plan analysis of this zone similarly examined space provision and design; functional suitability and utilisation; and spatial relationships.

Space provision and design: There is one large open space accommodating major trauma examination trolleys. There are two major examination rooms;, and also two resuscitation rooms with x-ray facilities located on the ceiling space to facilitate an unbroken sequence of medical attention to priority one patients. In addition, there are three treatment spaces located off the A&E unit corridor for medical attention to urgent and non urgent patients in need of treatment after medical examination. The project brief given by the clinical managers included the following optional spaces, for which there are no general and specific design requirements in the DGAEF: paediatric, psychiatric, gynaecology, ear nose and throat and poison control rooms. Additional space was also provided for legal cases such as rape, assault and drunkenness which are currently widespread in South Africa.

Space organisation and openings/penetrations: The floor plan configuration complies with the minimum design requirements in the DGAEF of 6 m^2 for closed or open cubicles in this zone. The spaces provided are open cubicles in a cluster arrangement, with limited space to accommodate equipments/supplies and family/visitors areas. In contradiction to the patient/family centred care principle, the design solution at this facility provides very low auditory and visual privacy, and does not support surveillance from the staff base.

Functional suitability, utilisation and spatial relationships: The design issues analysed in this zone are: estimation of number of rooms; circulation; adjacency matrix and level of spatial autonomy.

Estimation of number of rooms: There are only four examination/treatment spaces provided in this zone, which are inadequate for the average daily patient load. However, the DGAEF provide no guidance on estimation of the number of examination/treatment spaces.

Circulation, adjacency matrix and level of spatial autonomy: The results of Space Syntax, HTA and LA shown in Figure 7.6 demonstrate that the more the area provided for circulation, the less the space provided for examination/treatment areas. Indeed, circulation spaces in zone B represent over 25% of the overall area, which is 10% more than what is recommended in the DGAEF adjacencies.

The findings regarding functional space adjacencies and level of spatial autonomy revealed the following: poor interrelationships and adjacencies between spaces ; inappropriate connection/separation between spaces resulting in long travel distances for caregivers during A&E operations; and inappropriate levels of openness/enclosure, thereby comprising patients privacy and dignity.

7.5.3 ZONE C

Short stay inpatient area

The DQIs used to evalaute space design and provision in Zone A and Zone B above were also used to evaluate the influence of the DGAEF on space design and provision of the short stay inpatient area (Zone C).

Space provision, design, spatial relationships and utilisation: The provision of clinical decision units in the PAH A&E facility is as follows: one six-bed room; one two-bed male room; one two-bed female room and a one-bed isolation room. Respectively, the sizes of these spaces are: 6 m^2, 12 m^2, 8 m^2 and 12 m^2. With the exception of the one-bed isolation room, all the inpatient rooms are without patient ablution facilities as this is not a design requirement in the DGAEF for this space. The design brief for this zone in A&E unit is given to the design team by the clinical managers.

Space organisation, estimation of number of rooms, adjacency matrix and spatial autonomy: The spatial arrangements are in clusters of: one six-bed room; two male/female two-bed rooms; and one single-bed room with only curtain closures on almost all sides. Indeed, this study confirms that the spaces provided in Zone C is inadequate owing to lack of design requirements in the DGAEF.

The clinical observation spaces are located in different areas in this unit and the design does not support surveillance from a single staff base in this zone. The multiple-bed room arrangement with curtain closures around the patient's core-bed space compromises patient's privacy and dignity. Moreover, the empirical findings reveal the following issues: restricted circulation space; inadequate therapy space; less flexible and adaptable spaces.

7.5.4 ZONE D

Support areas: (staff facilities and ancillary spaces)

The same DQIs used in the analysis of zones A, B and C—space provision and design; functional suitability and utilisation; and spatial relationships—were used to gain insights in to the effect of DGAEF on Zone D.

Space provision, design, spatial relationships and utilisation: The result of the floor plan analysis on: space provision, sizes, configurations and location confirms that the design of the support spaces in Zone D does not follow patient/staff centred design principles. This assertion is based on the findings of the space organisation/utilisation and adjacency matrix/level of autonomy in these areas: rest and recreational spaces; overnight accommodation; change rooms with associated facilities; offices; education and training facilities and the storage facilities.

Space organisation and utilisation: The spatial organisation and location of most of the ancillary areas impacts negatively on the daily operations of the caregivers owing to the number of journeys they have to make to and from these spaces, especially during medical attention to patients. This is supported by the results of the LA used to record and analyse movements among components such as furniture and equipment/devices (see 7.4.2 zone D). Figure 7.4 shows the result of the Space Syntax visual entropy on spatial arrangements of the offices, education and training facilities.

Adjacency matrix and level of autonomy: The findings reveal that not locating most of the stores and other ancillary spaces where they are needed results in: constant visits to these areas by the caregivers; reduced time for medical attention; constrained interaction between caregivers and patients/families/visitors; and low capacity efficiency.

Figure 7.4: Space syntax analysis - Visual entropy

7.6 Floor plan analysis based on Planetree principles

The design and operational challenges identified in this facility, and their implications for the DGAEF update based on Planetree principles are discussed below under the following headings: DGAEF as medium of communication; DGAEF as tool for efficient and effective use of resources; DGAEF as a means for user participation; DGAEF as a means for technology innovation; DGAEF as a tool for institutional transformation; and DGAEF as a medium for standardisation of project development process.

7.6.1 DGAEF as a tool for communicating project aims and objects

The design tools that the findings suggest should be addressed in the DGAEF update are: project brief document; design solution approach and project implementation systems.

Project brief definition: The issues identified that need to be analysed and updated overtime owing to inevitable change are: definition of project scope, space narrative, room data requirements, standard project development tools and project budget.

Definition of project scope, space narrative and requirements: The space design and provision in zones A, B, C and D comply with the requirements of the DGAEF. However, the space organisation, functional suitability and space relationships scored poorly based on Planetree principles. This points to the need to update the approach in the DGAEF for developing the project scope of work; functional space narratives and space programming requirements; and for the quality of the information to be evaluated using the KPIs discussed in section 7.3.4.

Standard systems, room data requirement, furniture/equipment schedule and budget: The spaces provided, although complying with the DGAEF requirements, cannot accommodate modern A&E approaches that call for clinical activity and storage, and space for family members/visitors, at the bedside. This suggests the need for exploring new approaches to space design and provision of these spaces. The findings make clear that improving only the method for definition of the project scope and space functions is not sufficient; and also support the argument for multi-use spaces (see 2.7).

The results of the floor plan analysis suggest that it is important to define in detail the standard project systems to be used for: space design requirements; room data information; equipment/furniture schedule and project budget in the DGAEF.

7.6.2 The influence of DGAEF on efficient and effective A&E facilities

The design solution begins once the project brief documents are finalised and issued to the design team. Hence, the results of the floor plan analysis show that the space design and provision reflects the quality of the project brief, room data requirements, and functional and operational requirements elaborated during the briefing process. Therefore, the dynamic changes that can impact on the operational efficiency and effectiveness of A&E facilities should be addressed through continuous updates of the DGAEF. The design team should have up to date information systems to facilitate this.

The findings also suggest that facilities should be designed to optimise space utilisation by providing flexible and adaptable spaces based on new trends in operational processes. Hence the need to introduce KPIs to monitor observance of the new operational culture which should directly or indirectly impact on the efficiency and effectiveness of healthcare services delivery.

7.6.3 The importance of user participation in the project development process

The results of the floor plan analysis were used to evaluate the influence of the DGAEF on users' participation, and the implications for project development processes, in particular with respect to; suitability of spaces provided, comfort and sustainability.

Suitability of spaces, comfort and sustainability: The form and appearance of the spaces affect patients and caregivers experience, attitude and behaviour, as well as the latter's workflow operations which directly affect the quality of healthcare services delivery (Ulrich et al., 2004). The results of the observational studies support these findings based on the low scores for the design quality factors analysed using KPIs discussed in detail in part 7.4.2.

The study of the open cubicle cluster examination/treatment spaces, multiple bed rooms design for the clinical observation unit and location of the support areas provided in the PAH A&E facility reveals that these spaces are not in line with Planetree space design and provision principles (see 2.4 and 2.6). In fact, users involvement in the development of the design solution and floor plan configuration was very limited; hence, there is now need to address these issues: choice/control, acoustic/visual privacy and family/caregivers support spaces. Moreover, the finishes and materials used at this facility should have been informed by a broad based consultative approach to better address the question of life-cycle costing.

7.6.4 The effect of DGAEF on technology innovation

The findings highlighted a number of issues relating to technology innovation in the DGAEF, including integrating spatial organisation with engineering services and design solutions to improve space design and provision, quality of materials and finishes, and technical performance.

Integrating design and spatial organisation with A&E operations and engineering services: The findings revealed that the spaces in zones B and C differ in degree of flexibility, offering limited opportunity for multiple uses. In addition, the current space design and provision in this facility does not support transferability of priority 1, 2 and 3 patient's into any available alternative rooms. Hence, medical attention to patients must be provided in particular rooms, thereby, limiting A&E facility capacity efficiency and the quality of services delivery. However, the findings of the questionnaire and interview surveys and floor plan analysis are that the current situation can be improved through the use of technology innovation in DGAEF update based on Planetree principles.

7.6.5 The impact of DGAEF on institutional transformation and organisational change

The findings on the institutional culture and project development process point to the need to introduce in the DGAEF new systems to encourage the use interdisciplinary project team, for example, "design operational systems based perspective" which was discussed in detail in the previous chapters and sections (see 6.3.3 and 7.3.3). In general, the design team is appointed by the client to produce design and technical documentation information based on project brief; following which the construction company is appointed to execute the works (see 2.3 and 2.10). This traditional project development approach influences the quality of the outcome of the technical and construction information issued to other stakeholders.

The findings support the argument that the continued use the traditional project development approach results in unpredictable timeframe, cost and quality of the end-product. Hence the need for KPIs to evaluate the procurement systems, communication and project management approach in the DGAEF update, as argued in the literature (see 2.11.5).

Contract documentation, communication and management of project implementation: The floor plan analysis and interview findings reveal that the poor outcomes of the project development system used for this facility were due to these issues: use of the traditional project development and procurement approach; lack of KPIs and information systems for multiple procurement systems (since a large number of SMMEs were involved in this project); and lack of information systems for use of a multidisciplinary project team for this project. The lack of appropriate information systems in the DGAEF for project development of this facility resulted in an inordinate budget escalation. The original project cost estimate was USD 50 million, but the final construction cost, excluding ongoing minor works, was USD 100 million. These findings support the argument for the update of the project development approach and procurement systems in DGAEF.

Furthermore, the findings also indicate that the communication and management protocols used in this project are inconsistent, suggesting the need for the development of communication and management "toolkit" for measuring the efficiency and effectiveness of the project implementation.

7.6.6 The effect of DGAEF on standardisation of the project development processes

According to the findings of the questionnaire and interview surveys, the DGAEF used for space design and provision of healthcare facilities should impact positively on the patients/staff/visitors experience and on the quality of healthcare services delivery.[99] The findings of the floor plan analysis conducted at this facility support this argument and the need to introduce these KPIs: timeframe; quality of the product; aesthetics and satisfaction for measuring the standard development process introduced in the DGAEF update.

Quality of the product, time, aesthetics and satisfaction: the efficiency and effectiveness of the KPIs used for evaluation and continuous feedback of the outcome of the project development system in the DGAEF used for evaluation of this project shows low

[99] See 2.10.5, 3.13.3, 5.3.5, 6.4.5, 6.6.6 and 6.8.6.

scores on time; quality of the product; aesthetics and satisfaction. The floor plan analysis reveals that the project development process used for the spaces provided in zones A, B, C and D of this facility needs to be improved through evaluation using the following KPIs: configuration of the waiting spaces; social spaces (resource centre/library); family support area in the room: examination/treatment/clinical observation spaces and quality of auditory privacy and visual privacy (in particular to prevent noise and direct views from the adjacent patient spaces).

The findings show low scores from the analysis of the floor plan configuration, and that this has direct influence on the low capacity efficiency. This suggests the need for the following improvements to ensure positive measurable outcomes: placement of rooms according to operations systems by providing spaces to enhance communication between patient/caregiver/visitors; provision of multipurpose rooms; and location of services and supplies at patients bedsides.

Comparative studies in the literature reveal that healthcare facilities based on design decisions informed by credible research and using standard project development processes impact positively on workflow processes (Nestor, 2009). However, PAH A&E facility was designed without recognising the role that standard development tools can play in improving the A&E physical environment. Therefore, the update of the DGAEF based on Planetree and patient/staff centred care principles and standard development tools used for the design of floor plan layout should influence the quality of caregivers operations and should impact directly/indirectly on these issues: job satisfaction; stress levels; productivity and the caregiver's attitude and behaviour: towards patients and visitors.

In the literature, analysis of capacity efficiency focuses on two perspectives: resource availability and resource efficiency .[100] This study shows that the DGAEF used for space

[100] See 2.9, 2.10 and 3.13.

design and provision influence the quality of caregivers' operations.[101] The above findings suggest that providing KPIs for constant evaluation and feedback of project development processes and life-cycle costing should improve the quality of the physical environment.

C. RESULTS OF THE OBSERVATIONAL STUDIES AND SPACE SYNTAX TECHNIQUES

The least tangible issues in the identified themes—quality of the physical environment and perception—categorised under the design quality factors as function, technical performance and impact (see 2.14)—were discussed in the previous section without establishing KPIs for evaluating user satisfaction. The information systems for evaluating the design process and POE were also not explained in detail. Thus the findings presented in this section identify criteria for evaluating DQIs.

7.7 Influence of the DGAEF on the quality of the physical environment and interior ambience

Participant observation was used to gain a better understanding of space provision/design; functional suitability/utilisation and space relationship at PAH A&E facility designed using the DGAEF (see Appendix S). The DQIs were evaluated using behavioural mapping techniques, explained in Chapter Four (4.7). The themes identified from this analysis are consistent with the three that emerged from the literature review, questionnaire and, interview surveys, and floor plan analysis which are: design tools; quality of the physical environment and perception.[102]

Figure 7.5 below shows the observation points used for mapping and evaluating the caregivers/patients/visitors behaviours once inside this A&E facility.

[101] See 5.4.3, 6.3.4, 6.8.2 and 7.3.4.

[102] See 2.14, 3.13, 6.3, 6.4, 6.5, 6.7, 7.3 and 7.5.

Legend

Zone A | Zone B | Zone C | Zone D | Observation point

Figure 7.5: Pretoria Academic Hospital A&E facility - Observation points for space mapping

7.7.1 Zone A

Entrances, waiting, reception area and triage/pre-examination area

Space provision and design: The design variables that have the greatest influence on space provision and design are: spatial organisation and openings/walls penetrations. These were evaluated using design profiling measures scoring from very low to very high. Continuous interval observation recording sheets in combination with LA were used to evaluate the impact of the DGAEF used for the project development process on the actual space provision and design of PAH A&E unit.

Space organisation and openings/walls penetrations: The spatial organisation was evaluated using HTA and LA to address the challenges usually encountered by designer on these issues: space articulation and inflection; placement; circulation; massing and geometry. The criteria for evaluating the design of openings/walls penetrations focused on two DQIs used to evaluate the degree of architectural interior permeability: disclosure and mobility.

The overall floor area and floor to ceiling height of the spaces are according to the general and specific design requirements in the DGAEF. The space organisation of this facility is conditioned by sizes of the floor area prescribed by different functions leaving little flexibility. However, the designers would have used the opportunity offered to influence the perceptual sizes of the spaces. This can be achieved by using the abovementioned concepts and manipulating heights to improve impressions of the entrance area and circulations spaces. In fact, these observations were confirmed in low scores of the spatial disclosure analysis conducted while the highest scores for mobility evaluation were medium.

Functional suitability and utilisation: Important issues that should be considered when analysing functional suitability and space utilisation are: space use and occupancy level; space activities/workflow process and access/circulation/time. These issues were recorded in the continuous interval observation recording sheet based on the following measures: HTA/LA; entrance/exist counts; space use occupancy survey; and staff and patient pathways.

The findings of the observational studies on functional suitability and space utilisation were as follows:

Space use and occupancy level: The findings of the space use occupancy survey in Figure 7.8 below reveal that the population in this zone are constituted as follows: 4% caregivers; 44% patients and 52% visitors. In this zone, the visitors are the majority which is in line with the NHS Estates (2004) design guidelines ratio of 1,5 visitors for every patient. This investigation also revealed that the design of this area and due to low presence of the caregivers in the area as demonstrated empirically does not address security concerns.

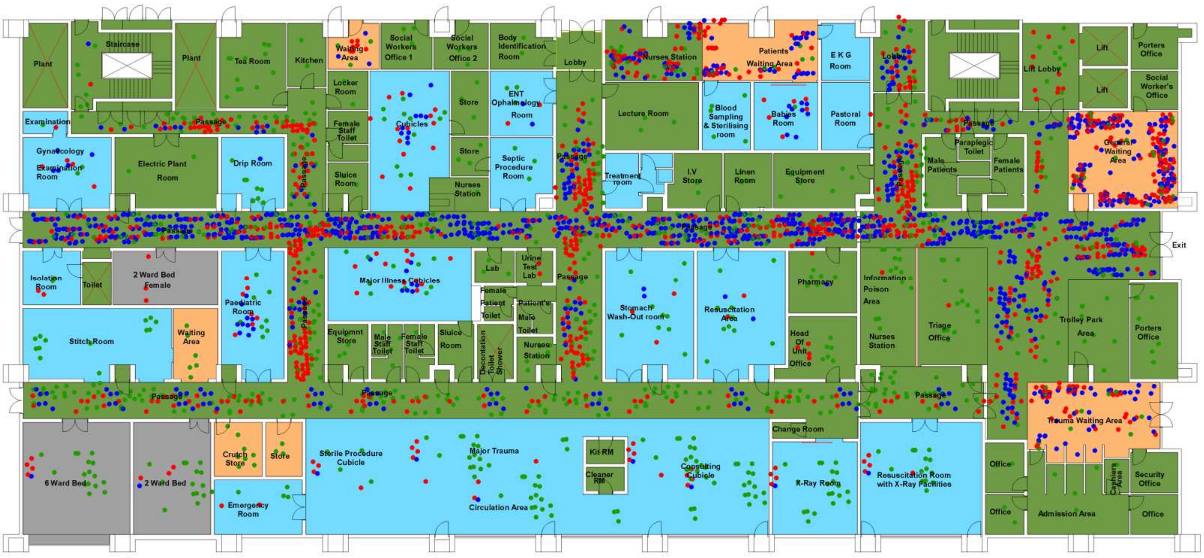
Space activities/workflow process and access/circulation/time: The results of the space activities/workflow processes, which were based on the analysis of the data and information captured using continuous interval observation recording sheets and HTA/LA, revealed that design of the spaces provided needs to be improved. In particular, the position of the admission/reception counter next to the recumbent patients entrances needs to be improved. The results of the entrance/exist counts survey revealed that location of the entrances supports efficient streaming of care. The physical design and location of the entrances needs to manage and prevent access to sensitive areas, as in the case of this facility.

It was observed that, on average, 55% of the patients/visitors movements were through the trauma patients' (P1) entrance. The evaluation of the ease of wayfinding, which is determined by the number of changes in direction necessary before arriving at the destination, found that wayfinding was a challenge and adversely affected access and circulation times.

*Spatial relationships and internal experience**:*** DQIs were defined in the continuous interval observation recording sheet and used to evaluate the spatial relationships and internal spatial experience. The design quality evaluation measures, ranked from very low to very high, used were the following: adjacency matrix; level of autonomy; internal finishes; quality of natural/artificial light and use of colour/texture.

Adjacency matrix, level of autonomy and interior ambience: The findings reveal detrimental fragmentation in the adjacency matrix. The desired and necessary relationships identified through HTA and LA are not accommodated in this unit; hence the highest score for the adjacency matrix was "medium". Children and social staff waiting spaces are located in different areas and not within the main entrance zone, making it difficult to centralise shared ancillary support services. Also, the design of key spaces provides inadequate levels of autonomy, which has a direct bearing on inter-connectivity between spaces and visibility.

The following design variables were used as DQIs to assess the quality of the interior ambience: spatial modulation, spatial texture and use of pattern. The quality of design of the interior space of this healthcare facility confirms the importance of healthcare institutions having a say in the interior architecture. The interior finishes materials and choice of colours used for PAH A&E unit were based on institutional building interior design architecture. The highest scores obtained on the level of interior design articulation/modulation and spatial texture analysis was medium and the scores for use of pattern were very low. The level of natural light inside the space is insufficient owing to the number of windows provided within this zone; and the DQIs scores were low which justifies the constant use of artificial light.



Legend

Zone A Zone B Zone C Zone D

Patients Caregivers Visitors

Figure 7.6: Space Syntax analysis - Space use and occupancy level

7.7.2 Zone B

Examination and treatment areas

The findings on the examination and treatment areas provided valuable information on the following DQIs identified and discussed in detail in Zone A: space provision and design; functional suitability and spatial relationships and internal experience. The measures used for evaluating the above DQIs were the same as those used in Zone A (see 7.7.1).

Space provision and design: The KPIs used in combination with the observation protocol sheet to assess the space design and provision of the rooms was spatial organisation, openings and wall penetrations system. It is essential to understand the impact that spatial organisation, openings and wall penetrations have on operational processes and the delivery of healthcare services.

Spatial organisation, openings and wall penetrations: The examination and treatment spaces provided at PAH A&E were divided and categorised into: major, minor, paediatric, resuscitation, and speciality rooms. The numbers and proportions of these rooms vary according to the operational culture of this facility. The medical attention to patients in this facility follows a broken sequence of clinical work process, compelling caregivers to undertake examination and treatment of patients in different spaces. The number of the rooms provided in this unit, the space sizes and floor to ceiling heights were according to the general and specific requirements in the DGAEF. The spatial organisation and design of the examination rooms is based on the open cubicle arrangement with curtains on three sides.

The results of the evaluation of space organisation recorded low scores based on the sets of criteria used for determining these design quality measures: articulation; placement; circulation; geometry; openings and wall penetrations in this zone (see 7.7.1). The findings are that without appropriate additions and alteration works, the spaces provided at PAH A&E unit cannot be efficiently and effectively used based on patient/caregivers principles of care.

Functional suitability and utilisation: The spatial functions and utilisation of the examination and treatment areas were analysed using these indicators: space use occupancy level, average turnaround time and circulation. The space use occupancy level and average turnaround time were, in turn, measured using: room entrance/exist counts, room profiles and pattern of movement of the caregiver's respectively.

Space use occupancy level, average turnaround time and circulation: The average daily patient loads in the different spaces—major, minor and paediatric examination and treatment areas—are as follows: patient's visits in the major and minor rooms are respectively 79% and 21% during daily shift distributions. This finding shows that the space provided for the major rooms is insufficient while there is redundant space in the minor examination and treatment cubicles. Moreover, the paediatric rooms have an average daily patient occupancy rate of 86%, which is highest during evening and night shifts.

The findings within zone B provided information on how long a patient spends in the major, minor and paediatric examination and treatment spaces. The findings revealed that on average emergent care patients remain in a major and paediatric examination/treatment spaces for 60 to 90 minutes. The average turnaround time for non-emergent care patients in the minor examination/treatment cubicles was between 30 to 50 minutes. Patient time in these spaces includes: time for undressing; receiving medical attention and dressing. The average turnaround time obtained from this survey excludes the total time spent by the patient in the waiting and pre-examination spaces.

Figures 7.9 and 7.10 show the axial mean depth[103] from and justified graphs[104] analysed respectively using Space Syntax techniques. The findings reveal that locating support and ancillary spaces away from the major and minor cubicles area is inefficient and ineffective due to interdependences of these spaces in relation to the activities of the caregivers within the examination/treatment cubicle. Indeed, on average daily shift distributions, journeys done by the caregivers to these stores from the examination/treatment cubicle amounted to 30 to 40 travels. Consequently, the journeys to the ancillary spaces measures between 1,050 metres and 1,400 metres. These findings point to the importance of locating support and ancillary facilities in areas easily accessible to the caregivers in order to improve capacity efficiency and throughput.

Spatial relationships and internal experience: The spatial relationships and internal ambience experience were observed, evaluated and scored from very low to high against the following DQIs: adjacency matrix; level of autonomy; internal finishes; quality of natural/artificial light and use of colour/texture (see 7.4.2).

[103] See 6.7.2

[104] See 6.7.2

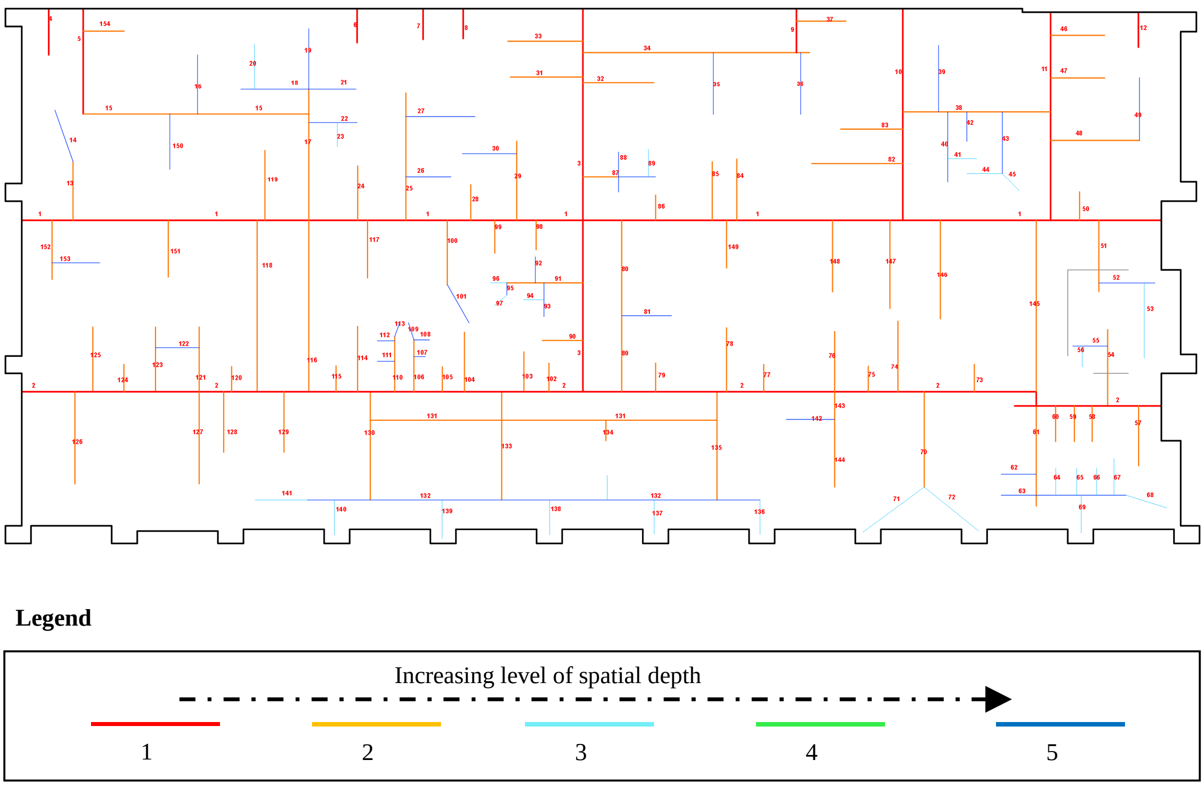


Figure 7.7: Space Syntax analysis - Axial map

Adjacency matrix, level of autonomy and interior ambience: The scores for the adjacency matrix structure were very low, meaning the spatial organisation of this facility does not support efficient and effective caregivers operations. This is due to the floor plan arrangement, whereby most of the ancillary and support areas are located outside the examination/treatment cubicles space. The level of spatial autonomy scores were also low owing to the use of clusters of cubicles with curtain closures on three sides. This floor plan arrangement provides very low visual and auditory privacy, thus compromising patients' privacy and dignity.

The findings on the interior finishes, colour, natural and artificial light—which were based on the following design quality measures: spatial modulation; spatial texture and use of pattern—confirm the need for user particpation in the choice of interior materials/finishes (see 7.4.2). The low scores also underline the need for KPIs to be used during project briefing, design development, project implementation, commissioning and POE.

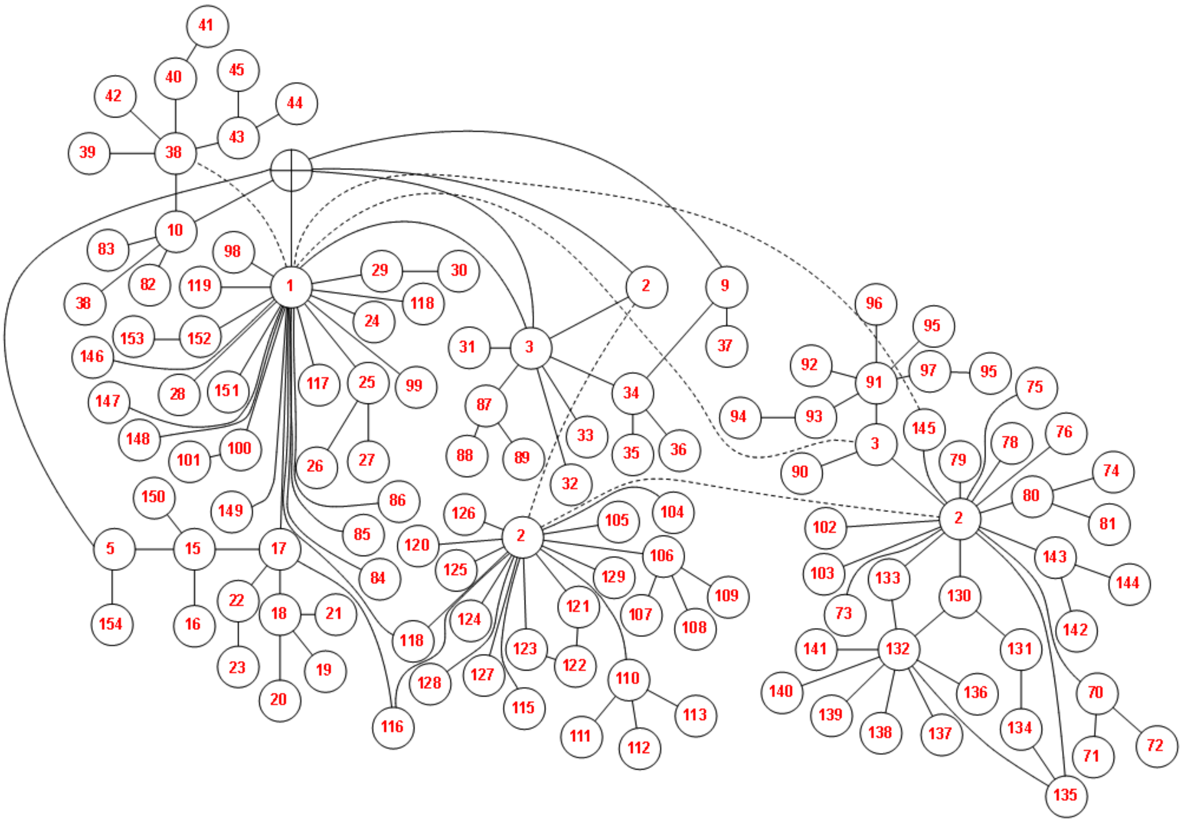


Figure 7.8: Space Syntax analysis - Justified graphs

7.7.3 Zone C

Short stay inpatient areas

The DQIs used in zones A and B for space provision and design, functional suitability and utilisation, spatial relationships and internal experience were also used for the investigation in zone C. These DQIs provided information on the influence of DGAEF on the space design, as well as behavioural cues of the users of the facility.

Space provision, design, functional suitability and utilisation: The findings on the clinical decision unit design provided in this facility were that it was not designed based on Planetree principles of care which stipulate the provision of an appropriate environment where patients’ needs are met and essential care is provided.

Spatial organisation, occupancy level and average turnaround time: The spatial arrangements are in clusters of: 1 six-bed, 2 two-beds and 1 single-bed rooms. The sizes and floor to ceiling height are designed according to the DGAEF. However, the spatial arrangements are not based on the Planetree principles of care; hence the overall scores for choice of the spatial organisation were very low due to: the multiple-bed arrangement; non provision of en-suite ablutions; and lack of suitable equipped space to support observation and monitoring of the patient. The average daily occupancy of these rooms is as follows: the two-bed and six-bed rooms are 33% and 47% respectively while the single-bed room is 53%. The results of the observation on average turnaround time in these rooms revealed that patients remain in this space for 90 to 120 minutes.

Spatial relationships and internal experience: The observational studies conducted in zone C also used the DQIs discussed in the preceding part of this section:

Adjacency matrix, level of autonomy and interior ambience: The clinical decision unit is not located in one area on the floor plan layout of this facility. The multiple-bed arrangement with curtain closures around the patient's core-bed space compromises patient's privacy and dignity. Only the six-bed cluster has adequate natural light, however, the position of the bed and the height of the window sill limit the extent to which a patient can see the views of the outside environment. Moreover, other rooms are constantly illuminated and ventilated artificially. The interior ambience of this zone is institutional: the rooms finishes are painted in white acrylic paint. The floor covering and skirting inside each patient zone are in multi-colour vinyl tiles, with patterns similar to those used in zones A and B.

7.7.4 Zone D

Support areas: (staff facilities and ancillary spaces)

The findings on zone D are presented in the last part of this section: the same indicators discussed earlier are also used this investigation. This study provided relevant information on: space provision and design; functional suitability and utilisation and spatial relationships and internal experience.

Space provision, design, relationships and utilisation: The support areas observed were: rest and recreational spaces; overnight accommodation; changing rooms and associated facilities; offices; education and training facilities; and storage facilities. The investigations focused on design issues relating to improvement of facility capacity efficiency, which is measured, in part, by the number of journeys by the caregivers to these areas using the same approach as for zones A, B and C above.[105]

Spatial organisation and utilisation: The spatial arrangements of the offices, education and training facilities, in terms of size and floor to ceiling height, are adequate according to the DGAEF. However, the spatial organisation of the staff rest and recreational spaces; overnight accommodation; change rooms and associated facilities, and stores does not address issues relating to the improvement of caregivers workflow processes. The overall scores for the spatial organisation of the staff accommodation and stores were very low due to the location of most of the stores away from where they are needed, resulting in unnecessarily long journey lengths and times for caregivers, which could be more effectively spent on medical attention and interaction with patients/family/visitors.

Adjacency matrix, level of autonomy and interior ambience: Figure 7.9 shows the minimum path travelled by caregivers in a daily average work shift. The scores of the adjacency matrix structure were low due to spatial organisation of the floor layout plan. Most of the stores are located outside the examination, treatment and clinical decision rooms. The findings in Zone D were that caregivers travel to the sluice and linen stores more than 30 times in a shift, which amounts to 1200 metres. The caregivers' visits to other stores such as: equipment and supplies stores are about 10 times during work shift distributions. The interior ambience of this zone is institutional,: in line with Zones A, B, and C.

[105] See sections 7.7.2.

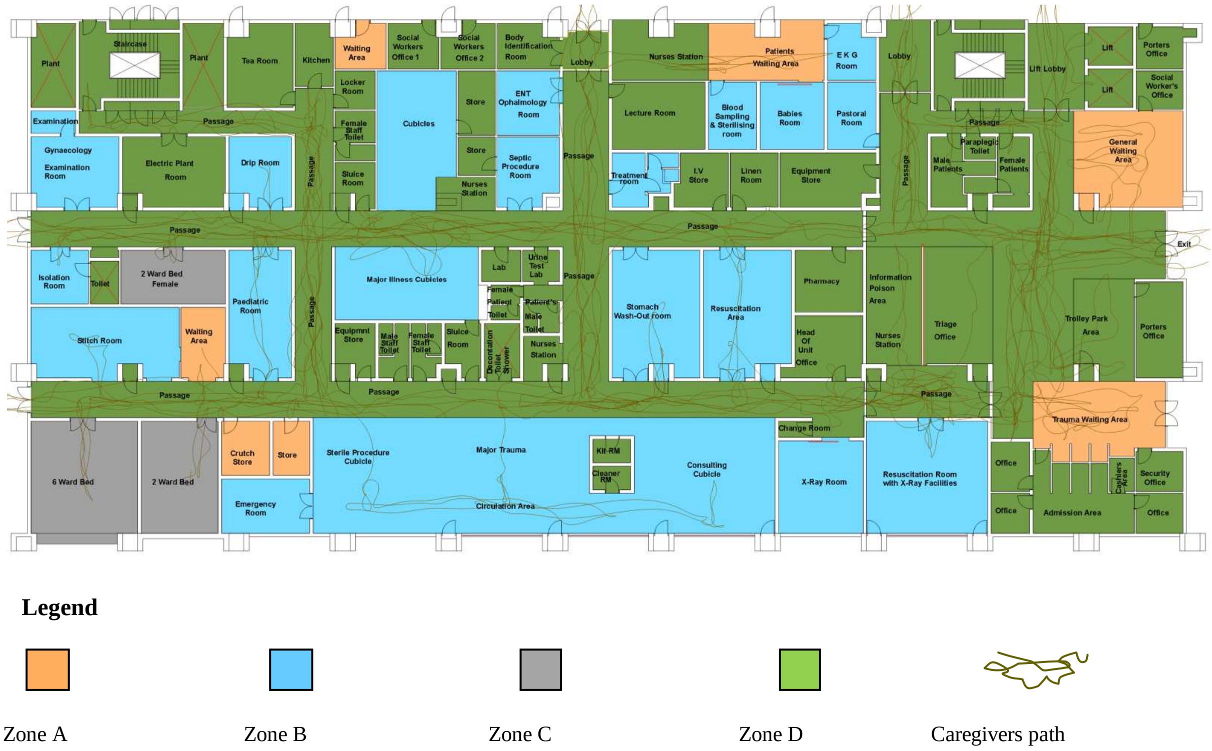


Figure 7.9: Space Syntax analysis - Minimum path travelled by caregivers

The issues emerging above, and confirmed in survey, interview and floor plan analysis, suggest the need to introduce KPIs in the DGAEF for the improvement of the spatial arrangement which may influence the capacity efficiency and level of interaction between caregivers and spaces.[106]

7.8 The new structure of DGAEF based on the Planetree principles

The preceding section presented the findings on the quality of the physical environment and interior ambience focusing on these design quality issues: function; technical performance and impact or perception. The influence of the DGAEF on these design quality factors were observed and evaluated to gain knowledge and understand the importance of their interrelationship, interdependence and interconnectedness. However, a clear consistent view has emerged from these results on how well the themes identified fit into the thematic categories discussed earlier in this section. This part of this section discusses in detail the identified design limitations and proposed solutions.

[106] See 2.7, 2.9, 2.10, 3.13, 5.3, 5.4, 6.3, 6.4, 6.6, 7.3 and 7.4.

The findings are discussed under these key aspects: DGAEF as medium of communication; the effect of DGAEF as tool for efficient and effective use of resources; the importance of DGAEF as a means for user participation; the influence of DGAEF as means for technology innovation; the role of DGAEF as tool for institutional transformation; and the importance of DGAEF as a medium for standardisation of project development process.

7.8.1 The influence of DGAEF on communicating the project vision and objectives

The findings of this study suggest the need to update of the following components in the DGAEF: project brief document; design solution approach and project development process systems is important in order to ensure the improvement of the A&E facilities physical environment.

Project brief definition: The above results agree with the findings from the literature, surveys, interviews and floor plan analysis that the main components of the project brief to be updated and adapted are definition of project scope, space narrative, room data requirements and project budget.[107]

Definition of project scope, narrative and space requirements: The findings reveal that the space provision in zones A, B, C and D complies with DGAEF design requirements. However, when analysed based on today's needs it does not meet users' expectations adequately. This is evidenced by the low scores obtained on these DQIs: space organisation, functional suitability, space relationships and interior experience used to measure project brief definition. Hence, the need to update the approach for developing: project scope of work; functional space narratives and space requirements. Indeed, these findings are consistent with Prasad's (2008b) view that a good design is based on understanding of users' needs relating to: space requirements; configurations; quality of the product; aesthetics and sustainability issues (in this case are: social, economic and political).

[107] See 2.9, 2.10, 3.13, 5.3, 5.4, 6.3, 6.4 , 6.6., 7.4 and 7.6.

Room data requirement, standard layout, furniture/equipment schedule and budget: The open cubicle arrangement with curtain closures, spatial arrangement and location of ancillary areas influence A&E capacity efficiency and quality of services delivery. Moreover, this investigation confirms that space design affects average turnaround time, caregivers' journeys, and levels of autonomy, which have implications for: privacy and dignity. These findings were also confirmed in the literature review, questionnaire and interview surveys, and floor plan analysis.[108]

The findings suggest that it is important to define, in the DGAEF update, the process of obtaining and including detailed information on room data requirements and equipment and furniture schedules during project briefing process. Moreover, these findings point to the need to develop in the DGAEF update a joint strategic and project briefing document explaining in detail general and specific requirements for each space to be used during: design; construction; detailed fit-out commissioning and A&E operations process.

7.8.2 The influence of DGAEF on efficient and effective A&E facilities

The findings revealed the need for DQIs in the DGAEF for defining the space planning; design development; adaptable and flexible spaces and technical documentation.

Design development, space planning, interior finishes and technical documentation: A most notable change in today's society is the increased expectation from the community on the quality of services delivery: in particular in the healthcare sector. The result of this investigation revealed that the quality of design solutions, space planning and interior finishes is influenced by DGAEF. Therefore, it is essential that design tools that influence and emphasise the need for quality of design solutions, space planning and interior finishes be developed in order to overcome the present constraints and limitations in healthcare facility

[108] See. 2.14, 3.13, 6.3, 6.4, 6.5, 6.7, 7.3 and 7.5.

design. The DGAEF should respond to change relating to political; economic; social and cultural circumstances of the local context.[109]

The results of the observational studies at PAH A&E facility demonstrate that design solutions, space planning and interior finishes are guided by the quality of information in the DGAEF. The quality of the information systems in the DGAEF should be seen as a catalyst which can either bring about desire to change or enable change.

This was confirmed by the low scores obtained for each category of the DQIs: space provision/design; functional suitability/utilisation; and space relationship at PAH A&E facility measured using the identified KPIs.[110]

7.8.3 The effect of user participation in DGAEF update and project development processes

The results from this investigation indicate that the quality of the information obtained during project briefing does not anticipate users' needs. Generally, only few caregivers are consulted during space narrative and programming for healthcare facilities projects in South Africa as revealed from the findings of this study. This project brief definition approach was also confirmed from the results obtained on the study conducted at CHBH A&E facility (see 6.12.2). In fact, the poor scores obtained on the analysis of the space design and provision of this facility reflect very limited involvement of users. These results are consistent with the findings from the literature, questionnaire and interview surveys and floor plan analysis.[111]

Suitability of spaces, comfort and sustainability: The low scores obtained on the POE of the space design and provision indicate that there was limited involvement of the users during project development. Thus, the completed facility now requires significant improvement to achieve the desirable measurable outcomes, and in particular to improve

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[109] See 3.5, 3.6, 3.7, 3.10 and 3.11.
[110] See 7.7.1, 7.7.2 and 7.7.3.
[111] See 7.7.1 and 7.7.2.

resources use efficiency, capacity efficiency and throughput. This findings is supported by the results obtained from the questionnaire and interview surveys and floor plan analysis.[112]

7.8.4 The influence of DGAEF on technology innovation and updates

The findings suggest the need for the update of the DGAEF to address the integration of spatial organisation with the engineering services; design solutions of the floor plan layout with A&E operations; the quality of the materials and finishes with technical performance.

The spatial organisation, engineering services and interior ambience: Designing integrated multiple use spaces: The findings revealed that the space sizes in zones B and C differ in the degree of flexibility, offering limited opportunity for multiple uses. Hence, at PAH A&E urgent patients cannot be treated in the minor examination/treatment spaces thereby limiting A&E unit capacity efficiency and also constraining the quality of healthcare services delivery. Moreover, the current space provision in this facility does not support transferability of P1, P2 and P3 patients[113] into any available alternative rooms, thus, medical attention to patients must be done in appropriate room category. Currently, according to data obtained from PAH (2006), and this investigation revealed that the number of A&E admission in this facility has risen dramatically. In fact, the above findings show that the low capacity efficiency at this unit was due to floor plan configuration and workflow systems.

7.8.5 The impact of DGAEF on institutional transformation and operational systems

The findings of the floor plan analysis recommend the introduction in the DGAEF update of the following KPIs for evaluation of the: procurement systems, communication and project management approach in the DGAEF update.

Contract documentation, communication and management of the project implementation: The findings from the observational studies and POE conducted at this facility reveal that the traditional procurement approach, which is a competitive tendering

[112] See 2.9, 2.10, 3.13, 5.3, 5.4, 6.3, 6.4 and 6.6.

[113] See 3.10.3.

system, was inappropriate for the construction of this facility. This is reflected in the numerous ongoing minor additions and alteration works, in particular for mechanical and electrical services. The design and construction period was also excessive— it took over 30 years to complete the facility.

This study indicates that the update of the project documentation; communication and management systems and methods is essential to the improvement of the project development processes for healthcare facilities projects.

7.8.6 Influence of DGAEF on standardisation of project development process and life-cycle costing

The findings reveal that DGAEF used for space design and provision in A&E facilities can significantly influence the outcome of the physical environment. The results from this investigation agree with the findings of the literature review, questionnaire and interview surveys, and floor plan analysis regarding the direct relationship between the DGAEF used for the design of the A&E facility and the quality of the physical environment. This suggests the need to introduce in the DGAEF update KPIs for evaluating the following design variables: spatial relationships; external/internal experience; quality of the product; time; level of satisfaction and quality of services delivery.

Quality of the product, time, aesthetics and satisfaction: The results of this investigation suggest that there is need to introduce standard project development systems to encourage a interdisciplinary project team approach, in light of the negative outcomes from using the traditional project development approach for this A&E facility. The findings reveal that the use of standard design tools for A&E facilities can improve the project development process, quality of the finished works and costs; and are in line with the literature, surveys, interviews and floor plan analyses.[114]

[114] See 2.9, 2.10, 2.6, 3.13, 5.3, 5.4, 6.3, 6.4, 6.6, 7.3 and 7.4.

The poor scores obtained from the evaluation of the floor layout configuration suggest that the DGAEF used for the space design and provision of this facility have led to the low capacity efficiency. Hence, the findings suggest that using standard project development tools should improve capacity efficiency and the quality of services delivery through placement of rooms according to operations systems; provision of spaces to enhance communication between patient/caregiver/visitors; provision of multipurpose rooms; and location of services and supplies at patients' bedsides.

7.9 Summary

Section A presented the findings and analysis of the interview surveys with the stakeholders at PAH A&E facility, focusing on the key themes identified in the literature review, and summarised in graphically Figure 2.6: design tools/project development process; quality of the physical environment and perception/impact. This investigation has revealed further insights into factors constraining the use of the DGAEF and pertinent to the DGAEF update. They include level of awareness, use and compliance to the DGAEF; the influence of DGAEF in achieving healthcare facility development goals; the effects of DGAEF on institutional culture; KPIs for improving A&E facilities project development; and standardisation, customisation and technological innovation of the overall project implementation process.

Table 7.2 summarises the identified design challenges, environmental and design issues and themes they may influence DGAEF update.

Table 7.2: Identified design challenges and environmental issues relating to the themes influenced by DGAEF

Identified problems	Environmental design issues	DGAEF themes
Poor communication medium	Provision of adequate functional and operational spaces	Design tools/ Quality of the physical environment/ Institutional Culture
Inadequate measures for monitoring design process and implementation	Informed floor plan configuration and interior ambience	Design tools/Space functions/Operational Organisation
Insufficient comparative information on previous projects	Improved floor layout design, room sizes and built form	Design tools/ Perception/Ambience
Unified and standardised design project implementation protocol	Influences adequate provision of facilities and improves budget prediction	Design tools/ Perception/Social integration
Translation system for technological innovation	Limits design and project implementation timeframe	Quality of the physical environment/Institutional culture
Definition of POE protocols for completed projects	Impacts positively on the design of quality spaces and on the physical environment	Design tools/ Quality of the physical environment/ Social integration

The participants also suggested ways in which the above could be addressed; for example, the introduction, through DGAEF update, of KPIs for evaluating the following project development process variables: time, budget and quality of the finished product. They also recommended that the following issues be explored further in the DGAEF update: the vital role of DGAEF on healthcare facility and community; design solutions and implementation through participation; measures for the use of integrated project development approach in the DGAEF; a new approach to space design and provision, functional suitability, spatial relationships and operational systems; and research based measures to improve project development process in DGAEF.

Section B presented the floor plan analysis, and revealed that there is a direct relationship between DGAEF and the quality of the physical environment. The findings of this study provided empirical evidence of the need to develop KPIs to be introduced in the DGAEF update, which could include set goals that can be established during planning, design, construction, commissioning and POE, so as to enable continuous feedback for update of the DGAEF.

In the first part of this section, space functions and evaluation of floor plan configuration were evaluated. The findings suggest that DGAEF used for the design of the floor plan configuration were outdated and provided insufficient information for the design of examination/treatments spaces; caregivers' work space configurations; desired adjacencies; and access to support/ancillary spaces for medical supplies/equipment.

The key obstacles identified and their relevant solutions were discussed in detail in the second part of this section. Indeed, work-force efficiency and effectiveness were found in this study to be directly or indirectly influenced by the design of the floor layout plan which is based on the information available from the DGAEF.

Table 7.3 below shows the key issues and themes that should influence DGAEF update identified from the floor plan analysis conducted at PAH A&E facility.

Table 7.3: Identified design issues relating to the themes influenced by DGAEF

Design issues identified	DGAEF themes
1. Zone A • Registration area inappropriate • Layout that can improve patient/visitors surveillance • Triage space lacks privacy and dignity • More space for disaster preparedness • Inadequate waiting area	Design Tools Quality of the physical environment Perception Institutional Culture Social/economical/political integration
2. Zone B • Open cubicles design arrangements • Flexible/adaptable rooms • Layout that can improve patient/visitors surveillance • Privacy and dignity • Patient safety	Design tools Quality of the physical environment Perception Institutional Culture Social/economical/political integration
3. Zone C • Flexible/adaptable rooms • Layout that can improve patient/visitors surveillance • Restricted movement of the trolleys/charts/equipment	Design tools Quality of the physical environment Perception Institutional Culture Social/economical/political integration
4. Zone D • Provide adequate staff areas • More space in the ablution facilities • Location of storage	Design tools Quality of the physical environment Perception Institutional Culture

Section C presented the findings of the observational studies conducted at PAH A&E facility. In the first part of this section, the influence of the DGAEF on quality of the physical environment and interior ambience were investigated using the following DQIs: space provision/design; functional suitability/utilisation and space relationship and interior experience. The findings suggest that DGAEF used for the project development process of this facility are inappropriate in light of today's emphasis on human needs and physical comfort for patients/staff/visitors.

The new approach to DGAEF update based on Planetree principles is discussed in detail in the second part of this section. The fundamental obstacles to the design of a quality healthcare environment at PAH A&E facility, which should be addressed in the DGAEF update, are design tools; quality of the physical environment; and perception.

Table 7.4 summarises the identified design limitations, social, economic and environmental issues and the themes that should influence DGAEF update.

Table 7.4: Identified design limitations, social, economic and environmental issues and the themes that should influence DGAEF update

Identified design limitations	Social/economic/environmental issues	DGAEF themes
Scope of work definition	Design for changing needs and functions	Design tools/ Quality of the physical environment/ Institutional Culture
Space functions and room requirements	Shared vision and participatory planning	Design tools/Quality of the physical environment
Space provision and design	Access, equity and social inclusion	Design tools/Perception/Ambience
Spatial relationships	Social interaction and supportive design	Design tools/ Perception/ Social integration
External and internal architectural aspirations/expressions	Culturally informed design	Quality of the physical environment/ Institutional culture
Procurements systems	Make commitment and establish project goals	Design tools/Perception
Project implementation timeframe	Team liaisons project communication and coordination plan	Design tools/Perception
Quality of the environment	Build on progress, POE and feedback	Quality of the physical environment/Social integration/Value system

8 CHAPTER EIGHT

RESEARCH FINDINGS AND DISCUSSION

8.1 Introduction

This chapter discusses the key findings of the study, organising the emerging evidence from the preceding chapters in sequential order in line with the research aim and objectives; research questions; theoretical conceptual framework; data collection processes, analysis and findings. It concludes with a summary discussion of the future of the DGAEF in South Africa.

8.2 Overview of the research

Few studies have assessed the role of DGs for healthcare facilities, and more specifically A&E facilities, so as to make recommendations on how to improve their design and project development process. Indeed, the literature review identified that most DGs are developed and updated without research-based knowledge (Hamilton, 2009). This flawed approach to the DGs update process occurs both in developed and developing countries (Hignett and Lu, 2008a).

Much of the literature reviewed in Chapter Two underlines the importance of DGs in the healthcare facilities project development process, supporting the basic assumption of the study, stated in Chapter One, that the update of the DGAEF can improve the design of A&E facilities. Hence, the importance of exploring, understanding and gaining knowledge on DGAEF, including their role in and effect on the design and project development process.

The literature review focused on analysing current knowledge on DGAEF and identifying gaps therein; approaches to the interpretation, translation and application of DGAEF; and institutional, organisational and operational issues relating to the DGAEF. The knowledge gained informed the proposed conceptual framework for the DGAEF update (see Figure 2.13), and the research design and methods. The conceptual framework comprised the following key concepts that were identified as being fundamental to the improved design and project development process of A&E facilities:

(i) DGAEF as a medium of communication;

(ii) DGAEF as a tool for effective and efficient use of resources;

(iii) DGAEF as a means for participatory process;

(iv) DGAEF as tool for technology innovation and update;

(v) DGAEF as a means for institutional transformation; and

(vi) DGAEF as a tool for standardisation of the project development.

These key concepts provided the basis for the empirical research and data analysis; and will also guide the discussion in this chapter.

In order to analyse and discuss the research results in a way that is directly useful for informing the DGs update, the findings are analysed and discussed in relation to the primary and supporting research questions, and the key concepts above.

8.2.1 Discussion of the findings associated with the first primary research question: *Are DGAEF followed?*

Awareness, use of guidelines and compliance to the DGAEF:

The findings of the questionnaire and interview surveys reveal major differences in levels of awareness, use and compliance amongst consultants and government officials. The interview findings at CHBH A&E facility on the current level of awareness and use among government officials suggest that a certain depth of understanding of the *communication*, *feedback*, *evaluation* and *educational* tools is required. Similarly, the challenges faced by the project team in the design and project development process for CHBH A&E facility suggest that there are inadequate *communication*, *continuous feedback* and *evaluation* tools for analysing project briefing, design solutions, technical documentation, procurement, construction, commissioning, operation and maintenance, and project costs. The findings suggest the need for improved *communication; translation; feedback; evaluation and educational* tools to improve awareness, use of and compliance to the DGAEF.

DGAEF as a medium of communication: The findings from the questionnaire and interview surveys, floor plan analysis and observational studies reveal that the *communication tools* and information systems in the DGAEF influence the *interpretation*, *translation* and *application* of the general and specific design requirements.[115]

Introduction of comprehensive information systems to the project development process: The findings of the questionnaires, interviews, floor plan analysis and observational studies on the concepts of *integration*; *distribution*; *equity*; *attachment* and *value for money* reveal that the information systems in the DGAEF can improve the effectiveness and efficiency of the A&E facility project development process.[116] Information systems and data on the socio-political and economic context in the DGs influences choice of the design solution, materials, finishes and construction systems (Stichler, 2009).

Effects of DGAEF on effective and efficient A&E facility development: The questionnaire findings at CHBH and PAH A&E facilities reveal that lack of KPIs in the DGAEF can influence the level of compliance by the design team, at the expense of efficient and effective A&E facility development. The consultants' recommendation on the introduction of a good design brief and user-friendly, research-based DGs is consistent with that of Hayward (2006b) and Hignett and Lu (2008).

The findings from the interviews reveal that the outcomes of the CHBH and PAH A&E facilities are partly attributable to the quality of information in the project brief. The findings also support the view that project briefing, design and construction are interrelated, and a continuous process; and the consequent urgent need for the DGAEF update to improve the quality of the physical environment and users' level of satisfaction.

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115 See Chapters Two, Three, Five, Six and Seven.

116 See Chapters Two, Three, Five, Six and Seven.

The consultation and medical procedure with a patient generally requires between two to four caregivers and the use of space on all sides of the adjustable trolley. The observational studies at CHBH A&E found that, owing to the insufficient space provided, the examination adjustable trolley used for patient examination and treatment is positioned against the wall making it difficult for two caregivers to administer care from both sides (see 6.7.2).

The finding that there are significant differences in average turnaround times between the two facilities shows that using an unbroken sequence of the caregivers workflow process can improve capacity efficiency and resources use; and also the efficiency of multiple use spaces or rooms in A&E facilities. In this regard, Hayward (2006a) stresses the importance of information on average turnaround time for preparing space narrative and estimating space programmes. This finding is critical if the ACEP formula is considered for the DGAEF update as discussed in Chapter Three (see 2.11.2).

The floor plan analysis, observational studies and Space Syntax techniques done at CHBH A&E and PAH A&E facilities revealed that not locating stores and other ancillary spaces where they are needed results in: constant visits to these areas by the caregivers; reduces the time required for medical attention; low levels of interaction with patients/family/visitors; and reduced capacity efficiency. Thus, the spatial arrangement can significantly influence the level of interaction between caregivers and spaces.[117]

Project development process, programme, and budget: The case study of CHBH A&E facility reveals that the innovative project development approach adopted was successful. However, on the whole, project programmes for completion of healthcare facilities projects are excessively long. The two major effects of these delays are:

(i) under expenditure of healthcare facilities budgets; and

(ii) poor provision of A&E facilities and over expenditure when they are completed.[118]

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[117] See 2.9.3, 2 .9.4,3.13.2, 5.4.1, 6.4.1, and 7.4.1

[118] See Chapters Two, Three, Five, Six, and Seven.

Hence the urgent need to update the project management tools in the DGAEF in order to expedite the project development timeframe.

The case study of the CHBH A&E facility also demonstrates the need for more comprehensive technical information documentation. Numerous omissions in the bills of quantities have resulted in poor budget estimation and, consequently several requests for project cost increases due to constant project variations. This has escalated the construction cost from the original budget of USD 50 million to the final cost USD 100 million (see 7.3.3).

These findings emphasise the need for KPIs in the DGAEF for continuous evaluation of project technical documentation, the project development process and budgets. They also prove the worth of exploring integrated project development systems or "design and operational system-based perspective" (see 3.13.1 and 7.6.5), which can lead to improved *integration* of the project development process; and also address challenges related to human, financial and operational resources (Lehtonen et al., 2003; Sadler et al., 2008; Weitzner and George, 2009).

The findings on the first primary research question are summarised in Table 8.1.

Table 8.1: Summary of the research findings on first primary research question: Are DGAEF followed?

Research aim/objectives/questions	**Problems/challenges/obstacles/results/findings**
o **To critically review the role of design guidelines in healthcare services delivery process and identify challenges and obstacles to quality healthcare services provision** o **To investigate the role of DGs in the delivery of A&E facilities in South Africa**	
1. **Are DGAEF followed?**	o **DGAEF as a medium of communication**
1.1 Why are DGAEF important?	• Communication • Interpretation • Translation • Continuous feedback • Evaluation • Education
1.2 How can DGAEF improve project briefing documents?	
1.3 Can design development and documentation process be simplified?	o Effect of DGAEF on effective and efficient A&E facility development
1.4 To what extent do DGAEF influence project development process and programme?	• Integration • Distribution • Equity • Attachment • Value for money
1.5 What are the effects of DGAEF on project budgets?	

8.2.2 Discussion of the findings associated with the second primary research question: *How effective and efficient is healthcare services delivery from A&E facilities?*

Influence of DGAEF in achieving healthcare facilities development goals: The findings of the questionnaire and interview surveys, floor plan analysis and observational studies reveal the need to develop and introduce, in the DGAEF update, benchmarking tools to improve issues related to these concepts: *identity*; *obligation*; *influence*; *knowledge*; *involvement*; *performance*; *operational process*; *continuity*; *information* and *physical environment* (see Table 8.2).

Participatory approach: A participatory approach that involves all stakeholders may be difficult to organise for any community issue, and in particular for DGAEF update. Nevertheless, there are benefits in seeking the opinion of all relevant stakeholders in the DGAEF update, and also during the project development process (Carpman and Grant, 1993).

Interviews at CHBH A&E facility revealed that the participation of users during the pre-design stage through broad based consultation can stimulate positive attitude and behaviour of the users (6.3.3 and 6.4.2). This can help create a sense of *knowledge*, *identity*, *obligation*, *influence*, *involvement*, *ownership* and *attachment* to the healthcare facility (The Center for Health Design, 2009).

Findings from the interviews affirmed that participation of users can provide invaluable insights into various aspects of the briefing and design processes that can help preclude late frequent design changes and consequent increases in overall project costs, as in the case of the CHBH A&E facility. Indeed, the literature review findings revealed that users want to be *involved* and *identified* in decision making regarding the design of their healthcare facilities (Hamilton et al., 2008a).

The findings suggest the need for the introduction of KPIs for the evaluation of user participation on issues relating to needs, suitability of spaces provided, comfort and sustainability in the DGAEF update. Pietrzak (2008), and the Center for Health Design (2009) assert that a participatory approach process for DGAEF update should provide benchmarking tools for evaluating the quality of the contract documentation, communication protocols and management of the project development process.

The findings of the observational studies at CHBH A&E facility suggest that the caregivers were not adequately consulted during the design of the facility.[119] However, the inadequate consultation and inconsistencies in the project brief have led to a noteworthy change in the operational processes and culture in this facility. Specifically, an unbroken sequence for medical attention to the patient was adopted to address the challenges related to capacity efficiency and throughput.

The alternative workflow and operational processes adopted at CHBH A&E facility resulted in improved capacity and resources use efficiency and a 10% increase in daily throughput (Chris Hani Baragwanath Hospital, 2006). The innovative integrated multiple use space adopted owing to lack of space and daily patient load can be explored further in DGAEF update. However, the findings also reveal that the completed facility still requires considerable improvement to achieve the desired outcomes on daily workflow processes in zones A, B, C, and D, and to better address issues relating to resources use efficiency, capacity efficiency and throughput.

Circulation, travel distances and interactions: The findings from floor plan analysis, observational studies and Space Syntax techniques at CHBH A&E facility suggest that the project brief did not adequately anticipate users needs. The findings from observational techniques of Space Syntax on space organisation, openings and wall penetration used to evaluate the floor plan configuration are associated with the outcome on the level of: *communication, integration, accessibility, privacy, noise level, quality of spaces provided, performance, experience, and level of satisfaction of the users* within this facility.[120] Likewise in PAH A&E facility the findings revealed as follows: the greater the area provided for

[119] See Chapters Two, Three, and Six.

[120] See Chapters Six and Seven.

circulation the lower the space provided for examination/treatment area. The circulation spaces in zone B is over 25% of the overall area in this zones A, B, and C which is 10% more than what is recommended in the DGAEF (see 7.5.2).

The findings regarding space functional adjacencies and level of spatial autonomy revealed these issues: desirable relationships between spaces in this zone are inappropriate; the nature of connection/separation between spaces are also inappropriate resulting in long travel distances by the caregivers during A&E operations and the level of openness and enclosure are inadequate thereby comprising patients privacy and dignity.[121]

Malkin (1992b) suggests that appropriate use of symbolic content of architecture, can improve the choice interior space design, articulation/modulation, texture, and pattern as it relates to materiality, transparency, interiority (interior order, arrangement, eurythmy, symmetry, propriety and economy) and form and language.

These findings suggest that general and specific requirements for materials may relate to the celebration of the experiential and sensual dimensions of architecture, which can be achieved through the DGs used for both the exterior and interior building materials and systems.[122] Materials does not only inform a rational (meaning function value system and durability) or symbolic content but also conceptual responses to design problem. Furthermore, the DGs used for the choice of materials can be used to impose, institutional, authoritarian architecture; and can likewise be used to create a homelike and familiar physical environment.

The findings at both CHBH and PAH A&E facilities suggest that only few caregivers are consulted during space narrative and programming for healthcare facilities and also during project development process for public healthcare facilities in South Africa.[123]

Technology innovation and update: The questionnaire findings reveal a broad consensus on the need to introduce DQIs in the DGAEF for the evaluation of the level of

[121] See Chapters Five, Six, and Seven.

[122] See Table 2.2 and Chapter Six: 6.3.4; 6.4.5 and Chapter Seven: 7.4.5

[123] See Chapters Two, Three, Five, and Seven.

technology innovation and updates. The use of information and communications technologies (ICTs) can no longer be ignored, as it can facilitate improvements in the quality of the physical environment, caregivers operational process and performance (Bijker et al., 1989).

The, findings of the floor plan analysis at PAH A&E facility reveal that the space design and provision do not support *continuity* of medical attention and transferability of patients into alternative rooms. Thus, medical attention to patients must be administered in specific room categories (see 7.4.4). In contrast, the DGs used for space design and provision in the CHBH A&E facility facilitated the introduction of multiple use spaces through technology innovation.

The findings from CHBH A&E facility also revealed that it is essential for the design team to obtain comparative information through the use of technology for estimating workload prediction, desired operational systems and engineering services required in each A&E space (see 6.6.4 and 6.8.4). This will enable the provision of integrated and flexible/adaptable spaces necessary for improved *operational process.*

The floor plan analysis, observational studies and Space Syntax techniques revealed that technology innovation can be used as a tool for evaluating design information such as workload predictions, computer modelling, mock-ups and walk-through simulation.[124] Furthermore, using technology during the design process reduces the risks associated with consultants and clients not understanding the information contained in the briefing and design protocols, which commonly result in late approvals. This findings agrees with the need to introduce "design and operational system-based perspectives" for project development process (The Center for Health Design, 2009).The interview results affirm that the DGAEF update can assist stakeholders develop integrated design tools, procurement systems, communication protocols and project and construction management tools. These findings

[124] See Chapters Two, Six, and Seven.

indicate the need to focus on the use of design and operational system-based perspectives to ensure the improvement of the design and project development process (see 5.3.4 and 6.4.4).

The findings from the investigation the two case study A&E facilities suggest that introducing information systems for technology innovation in the DGAEF can positively influence the effectiveness and efficiency of healthcare services delivery.

Table 8.2: Summary of the research findings on second primary research question: How effective and efficient are healthcare services delivery from A&E facility?

<table>
<tr><th>Research aim/objectives/questions</th><th>Problems/challenges/obstacles/results/findings</th></tr>
<tr><td colspan="2">o To investigate the influence of DGs on the multidisciplinary project team and users in design, construction and operational processes of the existing A&E facilities
o To assess the role of DGs in the design, construction and operations of the existing A&E facilities in South Africa</td></tr>
<tr><td>2. How effective and efficient are healthcare services delivery from A&E facility?</td><td>o Participatory approach process DGAEF review and for project development</td></tr>
<tr><td>Can the opinion of the stakeholders influence DGAEF review?</td><td rowspan="2">• Identity
• Obligation
• Influence
• Knowledge
• Involvement</td></tr>
<tr><td>How can physical environment influence the quality of healthcare services delivery?</td></tr>
<tr><td>Can patient/caregivers/family centred design approach influence the quality of healthcare services delivery?</td><td>o Technology innovation and update through DGAEF review</td></tr>
<tr><td>What are the obstacles constraining the use of technology innovation and update for A&E facility design and operations?</td><td rowspan="2">• Performance
• Operational process
• Continuity
• Information
• Physical environment</td></tr>
<tr><td>How can DGAEF review influence the use of interdisciplinary design team for the project development processes?</td></tr>
</table>

8.2.3 Discussion of the findings associated with the third primary research question: *What are the contributions of buildings towards efficient and effective A&E operations?*

Effect of appropriate DGAEF on healthcare institutional organisational culture: The findings from the questionnaire and interview surveys, floor plan analysis and observational studies revealed that significant healthcare institutional change often requires accompanying DGAEF update for an improved healthcare facilities. There is an interdependent relationship between DGAEF and space design and provision, functional suitability, spatial relationship and healthcare institutional culture, and the efficiency and effectiveness of A&E facility operation.

The role of DGAEF on institutional transformation and change: The questionnaires findings from CHBH and PAH A&E facilities revealed that DGs can significantly influence an effective and efficient A&E healthcare facility design process, and which may take into account the tasks and systems involved in producing the work in the healthcare institution or a subunit of an organization. A&E healthcare facility project development process may have to focus on the way things are as an organization pauses to consider how to make things better in order to improve on these issues: *management*; *quality of services*; *procurement systems.*

The findings of the interview at CHBH A&E facility revealed that there is an interdependent relationship between DGAEF, design and the healthcare institutional/organisational culture (2.10.2). The respondents indicated that the DGAEF can influence the space design and provision that are unsuitable for present A&E facilities workflow processes. Most of the respondents agreed that existing floor plan configurations may not support today's culture for healthcare facilities services delivery based on the Planetree principles (2. 7 and 2.10).

The findings from interview at CHBH A&E facility revealed also that the appointment of a construction management firm to act as single entity responsible for the project was relatively successful. This innovative procurement system eliminates long bidding procedures required in the traditional procurement method, in which design is separated from construction activity. The benefits of using this procurement system include improved project brief, design, construction programme management and overall project coordination amongst the consultants and the construction firm.[125]

Furthermore, the procurement system at PAH A&E facility found that communication and *management* protocol used in the project development process was likely ineffective, inefficient and inconsistent, these issues may have led the original project cost estimate to

[125] See Chapter Six.

escalate two times more than the original estimate, excluding ongoing minor and major additional works. [126]

Although, the integrated project development process used at CHBH A&E was successful, it also highlighted some risks associated with this *procurement* approach related to: construction guarantees and *management* of defects liability periods for completed works. This study suggest that alternative *procurement* approaches, which are gaining in popularity in various forms, in particular for public sector projects, in both developed and developing countries, may be considered in the DGAEF update. For example, the PFI approach has been used successfully in UK, by providing guidance for the use of interdisciplinary project team for healthcare facilities projects.[127]

The above findings suggest that there also a need for the introduction of benchmarking tools for evaluation of the *procurement systems*, and project *management* systems, in the DGAEF update. And that there may be a need for the developing project *management* “toolkit” for measuring the efficiency and effectiveness of the project development process, and A&E facility operational systems, in particular, in relation to the quality healthcare services delivery.

New design or renovation work can provide a unique opportunity for healthcare institutions to transform and improve their approach to healthcare facilities design, operational process, procedures, and culture (Hayward, 2006a). Design is a classic organizational intervention, which may lead to the improvement of workflow process, effectiveness and efficiency. Design can include work process mapping as one way to understand, evaluate, and improve a work environment (Hackman and Oldham, 1980).

Standardisation of the project development process and life-cycle costing*:* Attempts to introduce standard project development tools in the general and specific requirements in the DGAEF must be mindful of the relationship between social and technical issues during

[126] See Chapter Seven.

[127] See Chapters Two, Three, and Six.

project development process (Appelbaum, 1997). A cultural shift may be required for successful implementation of research-based change. For example, a study done by Argote (1982) reveals that coordinating workflow processes in an A&E facility based on standardisation of the whole process can contribute to improving healthcare services delivery.

The findings of the questionnaires at CHBH and PAH A&E facilities on standardisation of project development process revealed as follows: 97.7% of the caregivers favour the introduction of standard project development tools in the DGAEF update; in contrast, 97.5% of the consultants and 88.1% government officials were not in favour. The findings on the need to introduce benchmarking tools in the DGAEF for evaluating project life-cycle costs show that 78.5% of the consultants and 86.3% of the government officials respectively felt that there is need for it.

Although, the questionnaires findings at CHBH and PAH A&E facilities revealed that the consultants and government officials supports excluding information systems for standardisation in the DGAEF update. The interview findings on the use of standard project development tools in the DGAEF raised several concerns among the consultants.

While the caregivers argued in favour of standardisation of project development process as this new approach may fulfil project development needs to address the huge backlog in A&E facilities development and they claim may lead to the improvement of the quality of healthcare services delivery. According to A1, A3, and FN2 standardisation can thus improve end-product quality, project time and cost management, and experience and satisfaction of users.[128]

However, in contrast, the majority of the respondents are in favour of the introduction of information systems in the DGAEF update for determining and evaluation of project life-cycle costs. The respondents also indicated that it can be a solution for long-term

[128] See Chapters Six and Seven.

sustainability of A&E facilities, in particular with respect to: quality of the finished product; time; cost and healthcare services delivery.

The interviews findings at CHBH A&E facility suggest that standard project development tools used for renovation works at the CHBH A&E facility were successful. Majority of the responses obtained are of the opinion that this new project development approach can create a culture of standardisation and *pre-assembly* of construction processes and components,[129] especially for healthcare facilities projects. In addition, some respondents indicated that the use of standard project development tools can encourage the use of efficient and effective buildings systems, to ensure the improvement of the quality of the product, time and cost.

According to Appelbaum (1997), socio-technical theory suggests that combining culture change initiatives (social) and standardisation of facility design (technical) can enhance the likelihood of sustained positive change. For example, standardisation is capable of generating simple project development systems to ensure replicable good practice in design, construction and operations. Additionally, standardisation can facilitate *repetitive, flexible* and *adaptive* systems and, hence, *pre-assembly* and good *aesthetic* standards for healthcare facility design based on tested and agreed frameworks (Francis et al., 2001; Kahn, 2009b).

The floor plan analysis at CHBH and PAH A&E facilities findings revealed that there may be need for developing standard tools for monitoring constant changes in daily peak workload, (which is the one of the major critical issues facing A&E facilities today). And this strategy can influence the introduction of *flexible* and *adaptable* project development tools. Moreover, the introduction of information systems for standard building systems in the DGAEF can improve project budget prediction, and it will simplify budgeting issues. [130]

[129] See 2.8 and 4.3.2.

[130] See Chapters Two, Three, Five, Six, and Seven.

The findings of the observational studies and Space Syntax techniques at CHBH A&E facility point to the need to introduce generic standardised project development tools to improve the outcomes obtained using these concepts: *repetition, pre-assembly, aesthetics* and *satisfaction* for the project development process. Standard project development protocols can also provide solutions for *aesthetics durability and serviceability* of the healthcare facility environment, which relates directly to the quality of the interior space design and provision, functional suitability and spatial relationship (choice of the finishes, materials and colours).[131]

Table 8.3: Summary of the research findings on third primary research question: What are the contributions of the buildings towards effective and efficient A&E operations?

<table>
<tr><th>Research aim/objectives/questions</th><th>Problems/challenges/obstacles/results/findings</th></tr>
<tr><td colspan="2">o To explore the effect of the DGs on organisational process in the exiting A&E facilities
o To develop research based recommendations (guiding principles) for the design of A&E facilities in South Africa</td></tr>
<tr><td>3. What are the contributions of buildings towards effective and efficient A&E operations?</td><td>o The role of DGAEF on institutional transformation and change</td></tr>
<tr><td>Are the users satisfied with the design quality of the A&E facility?</td><td rowspan="2">• Accessibility
• Management
• Quality of services delivery
• Procurement
• Experience</td></tr>
<tr><td>How can physical environment improve A&E facility capacity efficiency?</td></tr>
<tr><td>Can the review of the DGAEF improve standardisation of the whole project development and operational processes?</td><td>o Standardisation of the project development process and life-cycle costing</td></tr>
<tr><td>What are the effects of DGAEF review on flexibility and adaptability of the space provision?</td><td rowspan="2">• Repetition
• Pre-assembly
• Aesthetics/durability/serviceability
• Flexibility/Adaptability
• Satisfaction</td></tr>
<tr><td>How can DGAEF review improve durability and serviceability of the space provision?</td></tr>
</table>

In the literature it is argued that the current interest in standardisation of project development processes stems largely from the dissatisfaction of clients in the way healthcare buildings are delivered (Francis et al., 2001). The three key factors identified as important indicators for performance in the project development process are time, cost and quality of the work (Wagenaar and Haas, 2009). Furthermore, the above findings suggest that standardisation can enable greater predictability in the project development process, with cost and time savings. Finally, can also improve the finished product quality measures: aesthetics; durability and serviceability (see 2.13.6 and 7.8.6).

[131] See Chapters Two, Three, Five, Six, and Seven.

8.3 SWOT Analysis of DGAEF

A SWOT[132] analysis was carried out to identify the strengths, weaknesses, opportunities and threats that the DGAEF and proposed DGAEF update present. The SWOT analysis was based on the proposed conceptual framework in Figure 2.13.

8.3.1 DGAEF as a medium of communication

The SWOT analysis of the strengths, weaknesses, opportunities and threats of DGAEF as a medium of communication, summarised in Table 8.4, reveals that the strengths include providing information, evaluation and translation systems that can inform the development of A&E facilities. The opportunities lie in the awareness of the need to improve the physical environment in A&E facilities; the recognised need for change based on societal and cultural trends; and the potential for addressing social, economic and cultural challenges through effective communication systems in the DGAEF used for project development process. [133]

The analysis of the floor plans and workflow processes at CHBH and PAH A&E facilities pointed to the following weaknesses in the DGAEF: inadequate information in the general and specific design requirements; fragmentation of the general and specific design requirements; and an inadequate translation strategy. The threats to the DGAEF update process, as identified in the interviews, include lack of interest in research on the part of stakeholders; attachment to the existing project development culture; and political interference.

[132] Strength-Weaknesses-Opportunities-Threats (SWOT) analysis is mostly used to identify and access the Strengths, Weaknesses, Opportunities and Threats of an organisation or system. It is a useful tool for understanding and decision-making for all sorts of situations for any organisation or system, enabling proactive thinking rather than relying on habitual or instinctive reactions (David, 2001):

- Strengths refer to the effectiveness and efficiency of the capabilities and resources that can be used as a basis for developing and improving the organisation/system. For example, the effect of design tools in the DGAEF used for space design and provision, functional suitability and spatial relationships can result in measurable positive outcome for A&E facility development.
- Weaknesses refer to the absence of certain strengths that may be used as a basis for developing and improving the organisation/system. For example, lack of review of the DGAEF is considered a drawback to improvement of A&E facility development.
- Opportunities refers to the external environmental factors that can be exploited to develop and improve the organisation/system. For example, review of the DGAEF can create new opportunities for the improvement of design tools in the DGAEF used for A&E facility projects.
- Threats refers to the changes to the external environmental factors that can compromise the development and improvement of the organisation/system. For example, focusing on addressing only cost and room sizes in the DGAEF is considered as threats to the improvement of the A&E facility developments.

[133] See Chapters Two, Three, Five, Six, and Seven.

Table 8.4: DGAEF as a medium of communication

Strengths	Weaknesses	Opportunities	Threats
• Information systems • Evaluation systems and continuous feedback process • Translation systems	• Inadequate information in the general and specific design requirements • Fragmentation of general and specific design requirements • Inadequate translation strategy	• Awareness of the need to improve the physical environment in A&E facilities • Recognised need for change based on societal and cultural trends • Potential for addressing social, economic and cultural challenges	• Lack of interest in research from stakeholders • Attachment to the existing culture • Political interference

8.3.2 DGAEF as a tool for effective and efficient use of resources

Project briefing, design and construction are interrelated, interdependent and interconnected, and a continuous process, as the interviews with the consultants confirmed The findings reveal that, in this regard, there are strengths and opportunities in using DGAEF as a tool for effective and efficient use of resources, as shown in Table 8.5. As affirmed by several of the interview respondents, the strengths include better integration and use of resources for space design, functional suitability and spatial relationships; improved distribution and equity in use of resources; and greater emphasis on value for money. The opportunities presented by the DGs update include providing research-based guidance on efficient and effective resources use (see 3.12.2, 6.7.2, and 7.7.2).

The findings from this study are that DGAEF update can provide valuable information through the general and specific design requirements that are essential to improving the design of A&E facilities. Improving the physical environment can streamline and enhance workflow processes and reduce time-consuming tasks by simplifying their operations, thereby improving A&E facility capacity efficiency (see 6.6.2 and 6.8.2).

Lack of effective and efficient project development processes, and ineffective and inefficient design and construction systems are identified as a major weakness in the DGAEF in the interviews and observational studies conducted at the two case study A&E facilities. Others are: inappropriate distribution of resources and poor integration of space design and provision with services. The identified threats are the current focus on minimum square area and cost; lack of interest in change of the existing project development process; and limited financial and human resources.

Table 8.5: DGAEF as a tool for effective and efficient use of resources

Strengths	Weaknesses	Opportunities	Threats
• Better integration and use of resources for space design, functional suitability and spatial relationships • Improvement of distribution and equity in use of resources • Focus on value for money	• Lack of effective and efficient project development tools and processes • Ineffective and inefficient design and construction systems • Inappropriate distribution of resources • Poor integration of space design and provision with services	• Providing research based guidance on efficient and effective resources use • Improved provision of A&E facilities • Influencing better return on the investment	• Focus on minimum square area and cost • Lack of interest in change of the existing project development system • Limited financial and human resources

8.3.3 DGAEF as a means for participatory processes

The results of the questionnaire and interview surveys underscore that participation of stakeholders in the healthcare facilities project development process is of paramount importance, and that their opinions should be sought through consultation and included in the DGAEF update. The importance of obtaining space use requirements from users themselves during the pre-design stage through broad based consultation is also emphasised.

Effective knowledge sharing systems and engagement of key stakeholders and users to obtain information for project briefing, design and construction, which can help influence identity, obligation and involvement, are considered major strengths of the DGAEF (see 8.6). The possibility the healthcare institutions developing project visions and goals is seen as an opportunity and may influence the use of design system-based perspective for project development processes and operational systems.[134] The introduction of this new approach in the DGAEF is seen as an opportunity to improve integration of the project development process with all necessary engineering services, equipment, furniture and fittings.

[134] See Chapters Two, Three, Five, Six, and Seven.

Lack of evidence-based information resulting in use of subjective data and the opinion of a few individuals dominating the whole process are seen, by some of the interview respondents, as a major weakness of DGAEF as a means for participatory processes. The threats, as identified in this study and summarised in Table 8.6, include socio-economic and cultural contextual factors, such as the educational level of the community; and inadequate information systems leading lead to poor perception of the participatory process among stakeholders (see 8.6).

Table 8.6: DGAEF as a means for participatory processes

Strengths	Weaknesses	Opportunities	Threats
• Focus on knowledge sharing • Providing tools for engaging key stakeholders and users to obtain information for project briefing, design and construction • Influencing the use of these concepts: identity; obligation and involvement	• Lack of evidence-based information resulting in use of subjective data • Opinion of few individuals can dominate the whole process	• Healthcare institution ability to develop early project vision and goal • It can be a catalyst for the use of system-based design perspective for project development and operations • Better integration of the project development processs	• Lack of adequate guidelines • Limited information guidance on developing participatory processes • Socio-economic and cultural contextual factors (e.g., educational level of the community) • Inadequate information leading to poor perception of participatory processes

8.3.4 DGAEF as a tool for technology innovation

The interview findings affirm that technology innovation can be used in project development information systems such as workload predictions, computer modelling, mock-ups and walk-through simulation. Using technology during the design process reduces the risks associated with clients not understanding what is contained in design related documents, which commonly results in delayed approval of technical documentation (A3).[135]

The use of information and communications technologies (ICTs) which can facilitate improved project development processes, better workflow systems and environmental comfort, which interview respondents perceived as major strengths of the DGAEF. The opportunities they highlighted were more flexible floor plan configurations; easily adaptable and multiple use spaces; and development of a durable and serviceable physical environment,

[135] See Chapters Two, Three, Five, Six, and Seven.

as shown in Table 8.7—all of which will improve capacity efficiencies, resources use and quality healthcare services delivery.

The use of technology as a determinant tool instead of as an enabler for project development processes is considered a weakness, according to the interview results; while the low skills level compromising technology innovation are a perceived threat. [136]

Table 8.7: DGAEF as a tool for technology innovation

Strengths	Weaknesses	Opportunities	Threats
• Improved project development and operational processes • Better workflow systems • Focus on physical environmental comfort	• Used as a determinant rather than an enabler for project development • Inappropriate evaluation strategy • Frequent change in technology innovation	• Better flexibility in floor plan configuration • Easily adaptable and multiple use spaces • Development of a durable and serviceable physical environment	• Low skills level • Sustainability of constant technology innovation • Lack of integration strategy for technology innovation

8.3.5 DGAEF as a means for institutional transformation

The findings shows that the DGAEF update can provide an opportunity to introduce benchmarking tools for institutional transformation and the project development process, and to positively influence accessibility; management; quality of services; procurement and experience. Improvement of access to healthcare facilities, and providing guidance on more efficient and effective and efficient management and procurement systems are considered as the key strengths of the DGAEF. [137]

The identified weaknesses in the DGAEF include the procurement systems based on existing traditional and fragmented approaches; limited information for the integration of project briefing and design with procurement and construction systems; inflexible spatial relationship and a rigid project development process. Social, political, economic and cultural circumstances of the healthcare institution, the healthcare policy framework and attachment to the DGAEF currently used are perceived by the stakeholders as threats (see 8.8).

[136] See Chapters Two, Three, Five, Six, and Seven.

[137] See Chapters Two, Three, Five, Six, and Seven.

Table 8.8: DGAEF as a means for institutional transformation

Strengths	Weaknesses	Opportunities	Threats
• Improved access to the healthcare facility • Creating awareness for need to change the existing procurement systems • Effective and efficient management systems	• Inflexible spatial relationships • Rigid project development process • Fragmentation of the design, procurement and construction systems	• Predictable project development process • Focus on moral and ethical values • Improved services delivery	• Social and cultural context • Healthcare policy framework • Attachment to DGAEF currently used

8.3.6 DGAEF as a tool for standardisation

This study findings suggest that the introduction of information systems for standardisation in the DGAEF can lead to improvements of these issues: repetition; pre-assembly; aesthetics; flexibility/adaptability and satisfaction, as shown in Table 8.9. Provision of a standardised generic tool for project briefing, improvement and use of a pre-assembly construction process, which can enhance predictability of time, product quality and cost is also seen as a strength. The information systems for standardisation in the DGAEF update provide an opportunity to introduce life-cycle costing; improve capacity efficiency; and increase healthcare facility throughput.[138]

The existing A&E facility zoning system rigid floor plan configurations; inappropriate design tools, and the degree of standardisation of the project development process are perceived as a major weakness in the DGAEF. The key threats identified are limited design tools to adapt to local culture of the place, and lack of interest on the part of stakeholders in standardisation of the project development process (see 3.13.1, 6.6.6, and 7.6.6).

Table 8.9: DGAEF as a tool for standardisation

Strengths	Weaknesses	Opportunities	Threats
• Provision of generic tool for project briefing • Improve the use of pre-assembly construction process • Predictability of time, quality and time	• Current healthcare facility space zoning system • Rigid order of arrangement of the floor plan configuration • Inappropriate design tools to influence standardisation of the whole process	• Introduction of life-cycle costing • Improvement of the capacity efficiency • Increased healthcare facility throughput	• Limited design tools to adapt to local culture of the place • Lack of interest for standardisation by the stakeholders

[138] See Chapters Two, Three, Five, Six, and Seven.

In summary, the SWOT analysis reveals that the strengths and opportunities of the DGAEF update lie in developing general and specific design requirements by improving the following factors: communication, translation, evaluation, continuous feedback and learning.[139]

8.4 Interpretations and the strategy for DGAEF update

The findings and analysis of this study, and the SWOT analysis above, have identified many problems, challenges and barriers to the interpretation, translation and application of the DGAEF, as summarised in Table 8.4 to Table 8.9. These can be categorised according to their interdependence, interrelatedness and interconnectedness with the nine core Planetree principles that form the basis of patient-centred care—human interaction, information, healing partnerships, nutrition, spirituality, human touch, complimentary practice, alternative practice, and healing environments (see 2. 7). These principles have evolved through six important periods that have significantly influenced DGs for healthcare facilities development—the Early Ages, the Medieval, the Renaissance, the Nightingale period, the Minimalist Megahospital and the Virtual Healthscape (see Chapter 2.6).

Currently, interpretation, translation and application of the DGAEF focus on minimum standards and capital costs at the expense of quality and performance. Thus rational analysis is often replaced with misunderstanding based on faulty assumptions and emphasis on area and cost (3.12). The findings are that this is due in part to inadequate information and guidance tools in the DGAEF. These issues call for a reconceptualisation of the approach to the DGAEF update. The theoretical and empirical findings of this research suggest that Planetree principles can provide an alternative strategy for the DGAEF update, that will help provide an effective and sustainable response to the need in terms of A&E facility development.[140]

[139] See Chapters Two, Three, Five, Six, and Seven.

[140] See Chapters Two, Three, Five Six and Seven.

There are substantial reasons justifying an alternative approach to DGAEF update. On the one hand, there are inherent weaknesses and threats in the DGAEF and their use for space design and provision that emerged from the theoretical and empirical findings and SWOT analysis.[141] An important example is the fragmentation of the project briefing and design solution; and another is the lack of integration of engineering services with space design and provision. The result is floor plan configurations that are inflexible and inadaptable to future uses. On the other hand, there are the strengths and opportunities which may be capitalised upon (see Table 8.4, 8.5 and 8.6).

Indeed, based on the current healthcare system needs, the issues explored in the preceding chapters relating to socio-econo-political circumstances should be considered in the DGAEF update (see Chapters Two and Three). The strategies for addressing these issues should be research-based, supported by clear evidence, and involving all stakeholders (Chapters Two, Three, Five, Six, and Seven).

8.5 Issues limiting the use of DGAEF and the need for their update

The two case study A&E facilities reveal that the DGAEF update can play an important role in improving the general and specific requirements in the design tools used for space design, functional suitability and spatial relationships. However, healthcare institutions and other stakeholders are often faced with the dilemma of whether to comply with the DGAEF, as there are no benchmarking tools and little research-based information on the impact of the DGAEF on completed A&E facilities.

Patients, caregivers, family and visitors are now increasingly recognised as experts on the question of the quality of their experience—what matters; what enhances their recovery; and what is required to adapt to significant changes in their lives (Purves, 2009). Indeed, it is only them who can provide this information, which is essential to create improved healthcare

[141] See Tables 8.4, 8.5, 8.6, 8.7, 8.8, and 8.9.

facilities based on an understanding of how people experience their physical environment and what matters most. This information will serve to make the connection between the quality of the physical environment and the quality of healthcare services delivery. [142]

Furthermore, there is a dearth research-based knowledge about DGAEF, which is essential for the improvement of the space design and provision, functional suitability and spatial relationships. The identified problems and challenges limiting the use of the DGAEF present an opportunity to re-think their update and its update.

8.6 DGAEF as a medium of communication

The role of DGAEF as a medium of communication is influenced by a range of contextual factors, including historical and geographical factors; and political, economic, social, cultural and personal histories and situations.

8.6.1 Historical, socio-econo-political and, geographical perspectives

Following the first democratic election in 1994, black homelands were abolished and South Africa was divided into nine provinces. This was fundamental to addressing the prevailing political, social and economic situation after apartheid; and, in particular, the healthcare system (see Chapter Three: Section A).

The current political stability and significant changes since the first democratic election in 1994 notwithstanding, access to adequate healthcare services for the poor is still a big challenge. Current government expenditure on public healthcare facilities is inadequate and ineffectively used (Filmer and Pritchett, 1999); and there has been much focus recently on government under-spending on pro-poor healthcare projects (Whelan, 2000).

In this regard, two key issues that emerged should be considered in the DGAEF update. Firstly, A&E facilities provide a gateway to the healthcare system; hence the geographical context should be considered during planning and travel distances minimised.

[142] See Chapters Five, Six, and Seven.

Secondly, A&E facilities are a focal point of the healthcare system, accounting for a substantial percentage of inpatient care admissions, speciality consultations and ongoing outpatient care, particularly for poor communities (see Chapters Three and Five).

8.6.2 The importance of awareness and strategies to improve compliance to DGAEF

The design tools in the DGAEF can provide measures for obtaining adequate information to facilitate improved floor plan configurations and spaces. Indeed, many A&E problems and challenges relating to long waits, violence towards staff and patients, and lack of privacy and dignity are attributed to poor floor plan configurations; which are the result of information deficiencies in the DGAEF.[143]

Communication outcomes are affected by the quantity and quality of the information provided. This in turn has implications for interpretation, translation and application of the DGAEF. The theoretical and empirical findings and SWOT analysis identify weaknesses in the DGAEF relating to the quantity and quality of information in the general and specific design requirements.[144]

The DGAEF lack appropriate tools to assist healthcare institutions develop their vision for the facility. The project vision guides the design philosophy and concepts informing project development phases for both renovation and new work. Hence, the need for KPIs to ensure adherence to the vision and goals of the healthcare institution during project development phases.

The findings show that the right position, size, scale and proportion of a space is the most important programmatic need in zones A, B, C, and D.[145] These general and specific design requirements in the DGAEF play a vital role in improving workflow processes, resource use efficiency and effectiveness, and the quality of the physical.

[143] See Chapters Two, Three, Five, Six, and Seven.

[144] See Chapters Three, Five, Six, Seven..

[145] See Chapters Five, Six and Seven.

The findings reveal that at CHBH A&E unit, all four zones are inadequately designed in terms of space design and provision, functional suitability and spatial relationships for the average daily patient load and caregivers' workflow processes.[146] On the other hand, at PAH A&E unit, there was an effort to improve the space design and provision of the four zones; and especially of the entrances, waiting areas, examination and treatment spaces. However, adequate information in the DGAEF for the design of support spaces for families and caregivers in close proximity and good visual relationship to the examination and treatment spaces is still lacking. More detailed information is also required to ensure that examination and treatment areas can accommodate families' at patients' bedsides. This is one of the key principles of the patient centred care philosophy underlying the Planetree design approach.[147]

8.7 The impact of the DGAEF on efficient and effective A&E facility development

The findings in this section reveal the need for appropriate and adequate information systems in the DGAEF to improve the design tools components: project brief definition; design solution and project implementation process. The adequacy of the information systems also affects the efficiency and effectiveness of the overall healthcare system.

8.7.1 The healthcare system and activities in the A&E facilities

The WHO Declaration of Alma-Ata of 1978 of "Health for All" remains as valid today as when it was first adopted. Indeed, it is enshrined as a right in the 1996 South African Constitution to ensure that all citizens have equal access to quality healthcare services.

The DGAEF currently used have resulted in inequalities in resources use and distribution, and thus lack of healthcare facilities where they are needed most, as evidenced by the long distance travelled, especially by the poor, to the nearest A&E facilities.[148] The

[146] See Chapter Six.
[147] See Chapters Two, Three and Seven.
[148] See Chapters Three and Five.

redistribution of available resources necessary for equitable development of A&E facilities requires more efficient and effective management of the project development process.

8.7.2 Efficiency and effectiveness of use of resources and project development process

The interviews with the consultants and government officials who were involved in the renovation and new works at the CHBH and PAH A&E facilities confirm that inadequate design tools in the DGAEF led to a net increase in capital expenditure. This is because of misinterpretation of the recommended overall minimum planning area in the DGAEF as a point of departure for space design and provision, functional suitability and spatial relationships.[149] The determination of the space programme and estimation of the number of planning units is key to effective and efficient use of resources, and is an important component of the project briefing document.

The waiting areas at CHBH A&E unit are constantly overcrowded due to inadequate space provision; as are the three waiting areas in the PAH A&E unit. The findings suggest that the NHS Estates (2004) ratio may be appropriate for estimation of the area required for the waiting space; but a reduction factor may be required to avoid over sizing.

The four examination and treatment rooms provided in the CHBH A&E facility cannot handle the patient load. These rooms are currently used as multi-functional spaces to enable an unbroken sequence of medical attention to patients to cope with the overcrowding (see 6.7.2).

The number of examination and treatment rooms provided at the PAH A&E facility is also insufficient. Hence the major trauma spaces are often used as examination and treatment areas. A critical analysis shows that the mandatory 430 m^2 for the first 60 patients in a three-hour peak shift workload and 100 m^2 for every additional 50 patients' is the greatest weakness in the DGAEF. This is because key variables, such as estimated projected total daily peak

[149] See Chapters Three, Five, Six and Seven.

visits and examination turnaround time, are excluded.[150] It is important therefore to consider ACEP (2004), DGAEF when estimating the number of examination and treatment spaces, provided they are adapted to contextual and operational circumstances. Adaptable guidelines that enable individual healthcare facilities to modify the general and specific design requirements according to specific contexts, needs and uses should thus be introduced in the DGAEF update.

The analysis of the floor plan configuration of the CHBH A&E clinical observation spaces reveals that the average core bed space for multiple-bed room is 2.4 m x 2.6 m. A similar floor plan configuration is used for the PAH A&E clinical observation area. The average core-bed space area of 6.24 m^2 is in line with the recommendations in the DGAEF; but the findings of the study are that it is inadequate for today's A&E workflow processes. More room by patients' bedsides enables location of supplies and equipment within this space, thereby reducing travel distances for caregivers and affording them more time attend to patients and other duties. It also reduces the overcrowded atmosphere of the multiple-bed arrangement.

The current multiple-bed room floor plan configuration reduces privacy and dignity, and is considered inadequate for clinical treatment. Private rooms offer more opportunity for intimacy and dignity—but reduce possibilities for simultaneous supervision and interaction.

The findings reveal that there is inadequate information in the DGAEF on space design, functional suitability and spatial relationships for administration areas; education and training areas; caregivers areas; patients/caregivers/visitors ablutions; staff change and ablutions; stores and other ancillary areas. Hence, the findings suggest that the floor plan configuration should be informed by HTA, LA and Space Syntax techniques. This will also

[150] See Chapters Three, Six and Seven.

improve capacity efficiency, as the spatial arrangement of these areas influences caregivers' operational and workflow processes.[151]

The findings reveal that the sizes, scale and proportion of these areas, designed according to the general and specific requirements in the DGAEF, are inappropriate,[152] as are their overall location and proximity within the work activity areas. Thus, the overall scores obtained for the spatial organisation and floor the plan arrangement at CHBH and PAH A&E facilities were respectively "very low" and "moderate".[153] This underscores the need for DQIs in the DGAEF for improving spatial arrangement.

8.8 The importance of participatory processes through DGAEF

The study suggests that improved DGAEF are based on an understanding of the importance of listening to all needs and the active participation of key stakeholders—government; consultants; construction companies; academics; caregivers; patients and community—in all stages of A&E facilities project development processes. Each of the above groups has its own perspective and its own information about "how things work around here," as Scott-Cawiezell et al. (2006) put it, which is one of the key drivers of healthcare facilities environmental and operational culture.

8.8.1 The importance of patients/caregivers/visitors centred design approach

The involvement of users during the DGAEF update and project development process is considered important. Indeed, it is only logical and right that those who occupy and use particular physical environments may be involved in the formulation of the project briefing document. The findings from the interviews, floor plan analysis and observational studies conducted at CHBH A&E facility revealed that space design and provision for Zones A, B, C and D reflects project briefing information from limited sources.

[151] See Chapter Three, Five, Six and Seven.
[152] See Chapter Three, Five, Six and Seven.
[153] See Chapter Six and Seven.

When the A&E facilities at CHBH and PAH, which differ significantly in size, scale and the overall spatial configuration, are compared, the findings confirm that the space design and provision problems are similar for both. Of particular note is that the DGAEF used for the space design and provision, functional suitability, spatial relationships and architectural forms of the two A&E facilities are considered very strict, dominating, insensitive to the local and universal issues, and inappropriate (see 3.12).

The study findings underscore the need for project briefing documents developed through broad based participation. Indeed, 80% of the interview respondents consider project briefing documents developed with the involvement of the stakeholders absolutely necessary.

8.8.2 The effect of user participation from project briefing to commissioning and POE

The study findings reveal that design quality factors such as space design and provision, functional suitability and spatial relationships evaluated with KPIs are influenced by user participation. Indeed, this study maintains that user participation during project briefing, design solution and construction, and in the DGAEF update, can improve long-term positive measurable outcomes of A&E facilities.

The location of the support and ancillary spaces at the CHBH A&E facility reveals that the caregivers were not consulted during the project briefing, design and construction stages. The observational studies at CHBH A&E facility showed that caregivers travel, on average, between 1,000 and 1,200 metres in a work shift, wasting considerable time in hunting and gathering supplies and equipment and limiting the time spent by the patients' bedsides (see Chapter Six). This is likewise the case at PAH A&E facility (see Chapter Seven).

CHBH A&E facility scored "poor" on interior ambience, measured against the following KPIs: spatial modularity; spatial texture and use of pattern (see Chapter Six), while PAH A&E facility scored "moderate" (see Chapter Seven). This suggests the need for general and specific requirements in the DGAEF for interior finishes/colour and natural/artificial light. The institutional appearance of both CHBH and PAH A&E facilities underline the importance and need to encourage user participation during project briefing, design, construction, commissioning up till operations and maintenance. It is thus imperative that information systems and approaches for developing guiding principles for user participation during and after project development are considered in the DGAEF update.[154]

8.9 Technology innovation and update through DGAEF

Technology innovation and update is a central issue to be addressed in the DGAEF update as it has significant implications for space design and provision, functional suitability and spatial relationships.

8.9.1 The impact of technology innovation on design solutions and A&E operations

Technology innovation involves providing important resources and tools to support space design and provision, functional suitability and spatial relationships to improve A&E operations. A major weakness in the DGAEF, identified through the case studies and SWOT analysis of the DGAEF, is the inadequate use of technology innovation (see Table 8.7).

The problems and challenges arising from insufficient use of technology innovation and recommended ways to overcome them can be summarised as follows:

(i) Lack of emphasis on the use of research based data for updating of the project development process—project briefing protocols; design solution; procurement and construction systems; continuous performance evaluation and monitoring systems.

(ii) Poor data collection systems—for relevant data for project development, e.g., room data, finishes, furniture, equipment and technical performance data.

(iii) Limited use of communication and information systems—to inform good practice in space planning and design, engineering services and communication systems.

[154] See Chapters Two, Three, Five, Six and Seven.

8.9.2 The effect of technology innovation on the design of integrated multiple use spaces

The findings from the interviews, floor plan analysis and observational studies at CHBH A&E facility point to poor use of technology innovation for space design and provision. This, in turn, has led to continual revision of the project brief, adversely affecting construction time, cost and end-product quality (see 6.6 and 6.7).

The limited information in the DGAEF relating to technology innovation is partly responsible for lack of attention to design of multiple use spaces rather than the predominant multi-bed open cubicle floor plan configuration. It is also partly the reason for poor acoustic spaces; inappropriate daylight and lighting; poor ergonomic design and lack of adequate social support spaces.

Lack of use of technology innovation and update in the DGAEF is responsible for inadequate use of design benchmarking tools, such as HTA, LA and Space Syntax techniques, for strategic and project briefing; design solution; construction and POE. Inadequate use of these tools needs to be addressed in the DGAEF review; as inadequate design and construction information leads to indecision by stakeholders before and during project development. Furthermore, the current trend in humanisation of healthcare facility environments calls for continuous update of technology-based design tools in the DGAEF.[155]

8.10 The role of DGAEF on institutional transformation

Institutional transformation is an important aspect that can be significantly influenced by the general and specific requirements in the DGAEF.

8.10.1 Project briefing and design, procurement and construction systems

The findings reveal that the project development process is fragmented and in need of complete transformation. There are many gaps and weaknesses associated with the project

[155] See Chapters Two, Three, Five, Six, and Seven.

briefing, design and construction process, as the DGAEF are lacking in detailed information for space programming, space design and provision, functional suitability, spatial relationships, and adaptable and flexible spaces. Research-based evaluation systems for project briefing protocols; project scope; room data requirement and project costs analysis are also lacking.

The floor plan analyses of the CHBH and PAH A&E facilities show that space sizes and various measures for space design and provision meet statutory requirements. However, when analysed based on Planetree principles, these spaces do not meet the values influencing present trends in A&E facility physical environments. The lack of update of design tools in the DGAEF results in provision of insufficient space for patient comfort; patient privacy and dignity; family/visitors presence and social interaction. Hence the need for benchmarking/monitoring tools in the DGAEF. Absence of these tools in the DGAEF is considered one of the biggest challenges facing the improvement of A&E facilities development (see 6.6 and 6.7).

The traditional procurement and construction systems are seen as a weakness in the healthcare facility project development process, owing to lack of skills in the construction industry, escalating costs and extended project completion programmes.[156] The appointment of the main contractor through the Small, Micro And Medium Enterprises (SMMEs) programme was used for the first time for the new and renovation works at CHBH and PAH A&E facilities. This procurement approach worked successfully at CHBH A&E facility, but was unsuccessful at PAH A&E facility. The findings are that this procurement strategy may not be suitable for complex projects.[157]

There are several weaknesses and threats in the traditional procurement and construction systems in the DGAEF for healthcare facilities (see Table 8.9); and the findings

[156] See Chapters Five, Six, and Seven.

[157] See Chapters Two, Three, Five, Six, and Seven.

suggest that the communication and management protocols are inconsistent. The effect of DGAEF on KPIs for evaluation of the quality of the physical environment.

The low scores obtained from the observational studies conducted at both CHBH and PAH A&E facilities suggest that materials must be understood as having both a physical and spiritual significance. The findings indicate negative symbolic use and choice of materials, colours, textures, furniture, finishes and other interior ambience features. Indeed, both A&E facilities use hard wearing industrial materials which exemplify "sterility" of the interior ambience, sending an authoritative institutional message.[158] To avoid this perception, benchmarking tools for a participatory design approach should be developed and used to engage potential users of the facilities, as explained in Section 8.5 above. In this respect, there is need to develop KPIs to be introduced in the DGAEF for evaluation of the quality of materials, finishes and their respective technical, functional and aesthetic performance.

8.11 The role of DGAEF on standardisation of the project development process

Standardisation of the project development process entails creating intelligent information systems to ensure replicable good practice during strategic and project briefing, design, construction, commissioning, POE and operations.

8.11.1 Use of research based data for standardised tools for project development process

The study findings suggest that the healthcare services delivery function of the A&E facility can be improved through space design and provision that is comfortable, familiar and personal. The theoretical and empirical findings and SWOT analysis (see Table 8.9) also reveal the importance of designing "home-like" physical environments rather than the current "institutional" appearance of both the CHBH and PAH A&E facilities. In this regard, the lack of information on research-based standardised tools is seen as a weakness in the DGAEF used for space design and provision of these facilities. The findings argue that lack of standardised

[158] See Chapter Six and Chapter Seven: .

tools is responsible for the fragmentation of the spaces provided in zones A, B, C and D. This issue is also seen as a weakness that adversely affects operational and workflow processes.[159]

This study has shown that standardisation of the project implementation process relates to the regularity and repetition of the project briefing and design tools as well as procurement and construction systems. Consequently, dissemination of expert knowledge is vital to achieving good practice and equity of provision, which is linked to the three key guiding principles for standardisation: information systems; standard layouts and modular design and construction systems.

8.11.2 The influence of standardised tools in the DGAEF for quality services delivery

The patients, caregivers and other users' experience of the healthcare services delivery is the driving force that shapes the physical environment. The findings from this study point to ways to improve capacity efficiency, workflow process and throughput by addressing causal weaknesses in the general and specific requirements in the DGAEF.

The findings from the floor plan analysis and observation studies at PAH A&E facility reveal that space sizes in zones B and C differ in degree of flexibility and adaptability, but offer limited opportunity for multi-functional use. Medical attention to patients must follow the room arrangement based on the A&E case category—emergency or non-emergency cases. An unbroken sequence for medical attention to patient is not used in this facility; hence, the low scores on capacity efficiency and throughput.

The study findings reveal that simple transformation of workflow processes through standardisation of project development and operations processes, such as classifying minor and major treatment areas as multi-use spaces, adopted at CHBH A&E facility can considerably improve capacity efficiency and quality of healthcare services delivery. These findings support the need for providing design tools in the DGAEF for universal or acuity-adaptable rooms (see 6.7.2, 7.8.4, and 7.8.6).

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[159] See Chapters Two, Three, Five, Six and Seven.

8.12 The future of DGAEF

The problems and challenges identified in the DGAEF have been amply highlighted in the preceding sections prompting the question: "Do we need this design guidance?" The researcher believes that the answer is ”YES!”; but maintains that the DGAEF can be updated in line with the findings and recommendations of this study. The identified issues concerning the interpretation, translation and application of the DGAEF may be used as the point of departure in defining the problems to be addressed.

The main emphasis of the DGAEF is on area and cost; hence they are seen by stakeholders as a tool for controlling the area and cost of the facility. This view is too narrow. The DGAEF can be seen as a subset of healthcare system tools for addressing the problems and challenges relating to accessibility; equitable distribution of resources; responsiveness; efficiency; effectiveness; moral; ethics and value systems. Indeed, this study argues that, as A&E facilities are now a gateway to the healthcare system and used as primary healthcare facilities, the DGAEF can be based on the following principles: social model of care; patient/caregivers/family/visitors centred facility; and sustainability.

The degree in which a healthcare system can claim to be effective is related to the level of improvement over time in health indicators of the population served. The DGAEF can be used to facilitate the efficient and effective use of available resources, so as to enable equitable access to healthcare facilities, in particular for marginalised communities. Doing so will require that the DGAEF update take into consideration the development of DQIs for design tools (project brief definition, design solution and project implementation process); quality of the physical environment (integration of space design with engineering services and quality of materials); and perception and impact (spatial relationship and quality of services delivery) as shown in Figure 2.6.

9 CHAPTER NINE

CONCLUSIONS AND RECOMMENDATIONS

9.1 Introduction

This final chapter summarises the knowledge and understanding gained from the research process, findings and discussions from the preceding chapters. The implications of the findings and strategies for implementation of the new approach to the DGAEF update are presented; and evidence-based recommendations (guiding principles) for the design of A&E facilities in South Africa articulated. Finally, the limitations of the research process are highlighted; and areas for future research suggested.

9.2 Summary of the findings

This study set out *to assess the role of DGAEF in South Africa so as to make recommendations on how to improve their design and project development process*. With this overall aim, the research was directed towards six specific objectives:

1. To critically review the role of DGs in healthcare services delivery process and identify challenges and obstacles to quality healthcare services provision.
2. To investigate the role of the DGs in the delivery of A&E facilities in South Africa.
3. To investigate the influence of DGs on the interdisciplinary project team and users in design, construction and operational processes of the existing A&E facilities.
4. To assess the role of the DGs on the design, construction and operations innovation of existing A&E facilities in South Africa.
5. To explore the role of the DGs on organisational processes in the exiting A&E facilities.
6. To develop research based recommendations (guiding principles) for the design of A&E facilities in South Africa.

The key research themes and dimensions and sub-dimensions were identified through the literature review in Chapter Two. The knowledge gained from the findings of this chapter informed the philosophical framework underpinning the study and the development of the proposed theoretical conceptual model illustrated in Figure 2.7. The model comprised the following key concepts that were identified as being fundamental to the improved design and project development process of A&E facilities though the DGAEF update:

(vii) DGAEF as a medium of communication;

(viii) DGAEF as a tool for effective and efficient use of resources;

(ix) DGAEF as a means for participatory process;

(x) DGAEF as tool for technology innovation and update;

(xi) DGAEF as a means for institutional transformation; and

(xii) DGAEF as a tool for standardisation of the project development.

The conceptual model provided the framework for the empirical research and data analysis, and will also guide the discussion in this chapter.

The research context, South Africa, and more specifically Gauteng Province, was explored in Chapter Three. The influence of the DGAEF on the healthcare system policy in relation to efficiency and effectiveness of resources utilisation was investigated. The effect of DGAEF on the project development process was also discussed in Chapter Three.

The gaps in knowledge identified in Chapters Two and Three were categorised into three themes—design tools/project development process; quality of the physical environment; and perception/impact—which were empirically investigated in this study (see 2.13). Chapters Two and Three also informed the proposed theoretical conceptual model, as well as the research strategy and empirical study. The approach to fieldwork, data analysis and statistical tests are explained in detail in Chapter Four.

The analysis of the data collected from empirical studies was reported in Chapters Five, Six and Seven. These three chapters provide insights into stakeholders' views on awareness, use and compliance of the DGAEF, and the obstacles constraining their update. In addition, recommendations for the update of the DGAEF were discussed in these chapters.

The research findings and discussions from the preceding chapters, organised according to the research aim, objectives and questions, are summarised in Chapter Eight; and the future of the DGAEF discussed. Finally, guided by the conceptual model, this chapter proposes key recommendations (guiding principles) for the DGAEF update.

9.3 Recommendations (guiding principles) for the DGAEF update

The idea that DGAEF can improve the design of healthcare facilities has received relatively little attention in the literature, and there are no prior studies on DGAEF in South Africa. The problem statement with respect to the DGAEF, key research dimensions and sub-dimensions, research questions, data collection, analysis and findings, conclusions and recommendations have been presented and discussed in the preceding chapters of this study. The SWOT analysis, summarised in Tables 8.4 – 8.9, revealed the strengths and opportunities of the DGAEF and gave insights into the weaknesses and threats to be addressed.

The findings, conclusions and recommendations that have emerged from this study are presented according to the concepts identified as being fundamental to the improved design and project development process of A&E facilities:

(i) DGAEF as a medium of communication;
(ii) DGAEF as a tool for effective and efficient use of resources;
(iii) DGAEF as a means for participatory process;
(iv) DGAEF as a tool for technology innovation and update;
(v) DGAEF as a means for institutional transformation; and
(vi) DGAEF as a tool for standardisation of project development processes and life-cycle costing.

The practical implications; gaps and limitations identified; future research; generalization of the research findings and contributions to knowledge are also presented.

9.3.1 DGAEF as a medium of communication

The development goals adopted by the ANC Government at the 2007 Polokwane Conference were due to the poor outcomes of numerous policy initiatives to transform the healthcare system since 1994. This is confirmed by the low scores obtained in the WHO (2000) study cited in Chapter Three (3.8) that evaluated the following KPIs for healthcare systems: equity; efficiency; effectiveness and responsiveness, and is supported by this study. This is largely a consequence of the plural healthcare system comprising two parallel sectors, public and private, with different DGAEF for healthcare facilities development for each.

This study argues that the pressures on stakeholders involved in providing healthcare services leave little time for updating the DGAEF used for healthcare facility space design and provision. Indeed, the findings indicate that the information systems in the public sector DGAEF have limited, inaccurate and inappropriate data for planning, design, construction, commissioning, POE and maintenance of A&E facilities. Accurate and appropriate information systems in the DGAEF are essential for determining short and long term development goals and for life-cycle costing, as affirmed by various studies in the literature review (Purves, 2002; Sadler et al., 2008; Sheppard, 1989) and the interviews, and also by the floor plan analysis.

The information systems in the DGAEF constrain the improvement of A&E facilities, limiting their important role as a gateway facility into the healthcare system. A concerted effort is needed to eliminate significant identified threats such as lack of interest from stakeholders, political interference, and attachment to the existing culture and resistance to transformational change.

The findings also reveal that the information systems in the DGAEF relating to the general and specific design requirements lack tools for adapting to the dynamic nature of the healthcare system. There are no KPIs for assessing the impact of the key issues identified in the DGAEF to enable an iterative process of review and adaptation.

The SWOT analysis in Table 8-4 and 8-5 identifies the above issues as weaknesses in the DGAEF; but they also have strengths and opportunities which lie in the characteristics of the general and specific requirements used for space design and provision. Hence, more effort is needed to use the identified opportunities for updating and modifying policies and statutory requirements for regular and continuous updates of the DGAEF.

The four key recommendations (guiding principles) suggested are:

(1) Formulate strategies to improve information and communication systems in the DGAEF, and better manage data collection on healthcare needs for project briefing and design processes using systematic research.

(2) Commit to developing research-based benchmarking tools for evaluating the project development process in order to ensure that the vision and goals of the healthcare institution are continuously met, from strategic briefing, project briefing, design, construction, commissioning, POE, operations and till routine maintenance.

(3) Develop and introduce information systems for translation perspectives of the generic design guidance based on community, local, provincial and national needs in the DGAEF.

(4) Develop and introduce in the DGAEF information systems for dissemination of evidence-based knowledge on existing and new healthcare facilities.

9.3.2 DGAEF as a tool for effective and efficient use of resources

The backlog in development of A&E facilities in South Africa is a major constraint to the achievement of the healthcare system objectives of equity, efficiency, effectiveness and responsiveness. Indeed, since the first democratic election in 1994, overcrowding of L3 A&E facilities has been on the rise owing to the political, social, cultural, moral and ethical issues highlighted in Chapters Two and Three. The number of patient admissions has risen dramatically, but the development of A&E facilities has not kept pace.

Traditionally, capacity problems have been solved primarily through the DGAEF used for space design and provision; but the challenges arising from prevailing economic circumstances mean that available resources cannot support further increases in space provision. However, the findings from the floor plan analysis and observational studies at CHBH A&E facility reveal that little attention has been paid to how providing additional space can be avoided by optimising use of the current resources (see 6.3.3).

The analysis of the DGAEF indicates that the existing formula for estimation of the number of rooms and spaces needed in zones A, B, C and D is based on the universal guidance concept application system. In addition, there are also concerns raised regarding the omission of some of the key variables essential for the calculation of the space programme information used for project briefing, design and construction.[160] Therefore, the findings from this study have shown that there are inappropriate and inaccurate information systems in the DGAEF for space programming. Indeed, inadequate space programming is seen as one of the major weaknesses for the process of estimation of the planning units essential for efficiency and effectiveness of the use of resources.

Planning and categorisation of A&E spaces into zones which relate only to current operational policies has led to space design and provision with poor functional suitability, and which is less flexible and adaptable to inevitable future changes, as shown in CHBH and PAH A&E facilities.[161]

Thus, the recommendations (principles) are as follows:

(1) Zone A: Base the space programme for the entrance, waiting, admission areas and other facilities required in this zone on data on average daily, monthly and yearly attendance. Use NHS Estates (2004) planning units, with an empirically-derived reduction factor, for this zone where appropriate.[162]

[160] See Chapters Three, Six and Seven.
[161] See Chapters Five, Six and Seven.
[162] See Chapters Three, Six and Seven.

(2) Zones B and C: Estimate the space programme for minor and major examination, treatment and clinical observation areas using ACEP (2004) formula, using an empirically-derived alteration factor based on new construction and/or renovation works (see 2.11.2).

Use universal or multipurpose rooms for all A&E operations as they are very functional, efficient and effective in terms of utilisation rate (see Chapters Three, Five, Six and Seven).

(3) Zone D: Base the space programming for support and ancillary areas on qualitative as well as quantitative criteria. And use space dimension information in Neufert (2005), adapted based on HTA, LA and Space Syntax analysis, to determine size and design requirements for support and ancillary areas.

In addition, the following principles should be followed:

- Design of spaces used for accessibility should consider interrelationships, accessibility and provision of shorter walking distances for the caregivers and families as well as physical, visual proximities to ancillary and support areas.
- Spaces used for social interaction should provide quality spaces with vivacity of interior finishes, materials and colours to enhance social interactions that take place naturally or among other related spaces to bring different people together.
- Spaces for recreation and rest should include indoor gardens, libraries and common areas for family-staff interaction, and staff lounge/work area/meeting room (see 2.7).

Provision of these spaces will promote natural and programmed supportive social interaction among users, particularly caregivers. They will also enhance staff performance, relaxation, happiness and well-being, thereby influencing quality of services delivery and patients' medical outcomes.

9.3.3 DGAEF as a medium for participatory process

Participatory processes can stimulate positive attitude, identity, obligation, influence and involvement of stakeholders in the project development process. Indeed, users view design outcomes more positively if they have been involved and consulted adequately during the overall project development process.[163] Participatory methods should also be used to assess design-related organisational and operational issues. More attention needs to be paid to desired A&E workflow processes based on caregivers and other users needs, in particular patients and family members.

The use of the concept of broad based participation in the project development process also encourages an integrated interdisciplinary team approach; and hence a "design and operational system-based perspective". This alternative project development approach, which emerged from this study, is seen as a partial solution to the weaknesses associated with the traditional project development process (see Tables 8.4 and 8.5). The DGAEF update can create greater awareness of the role of "design and operational system-based perspective" in addressing issues relating to identity, obligation and influence, and positively influence desired outcomes.

The following recommendations (principles) are thus suggested:

(1) Encourage the use of participatory processes during planning, project briefing, design, construction, commissioning and POE through hard evidence; and develop and introduce KPIs for participatory processes in the DGAEF update.

(2) Develop and use toolkits for participatory processes for monitoring and evaluating participation during project development; and provide information on the criteria for stakeholder participation to ensure that it is representative, meaningful and substantive.

[163] See Chapters Two, Three, Five, Six and Seven.

9.3.4 DGAEF as a tool for technology innovation

The project development process of A&E facilities is heavily reliant on the approach for obtaining information on healthcare services delivery activities. There is lack of guidance on the application of technology innovation based on constantly changing local operational needs and processes. Furthermore, technology innovation is rarely used for continuous monitoring and evaluation of users needs taking into account inevitable change. And there is no structured approach through the use of technology innovation for co-ordination of information provided by the interdisciplinary team.

The failure of stakeholders to recognise the need to constantly improve the project development process through the use of technology innovation is due to poor knowledge systems and lack of information. More effort should be made in developing and providing technology innovation benchmarking tools in the DGAEF review to be used for space design and provision. There is strong relationship between the use of technology innovation and the quality of the space design and provision. As the SWOT analysis in Table 8.7 shows, the absence of this relationship is considered a threat to the improvement of the A&E facility.

There are no benchmarking tools in the DGAEF for initiating HTA, LA and Space Syntax analysis. Thus, these important technological tools for strategic planning and project brief definition are not utilised with research based information systems. The development of management skills to ensure appropriate use of these tools for data collection processes, which are essential particularly for space design and provision, is therefore encouraged.

Thus, the following key recommendations (principles) are put forward:

(1) Encourage the use of technology innovation to improve current poor data collection systems, and for developing project briefing protocols, design solutions, procurement and construction systems. In particular, use research to determine room data requirements, finishes, and furniture and equipment schedules for operational spaces in the A&E facility.

(2) Provide local, provincial and national co-ordination and leadership to improve skills in the use of technology innovation for A&E facilities project development, taking into account the many changes that occur during project briefing, design, construction and operation.

(3) Provide adequate information in the DGAEF relating to technology innovation to facilitate the design of more effective and efficient multiple use spaces.

9.3.5 DGAEF as a means for institutional transformation

Funding for public sector healthcare facilities development in South Africa generally comes from tax revenue; only a very small amount comes from user fees generated from healthcare services delivery charges. Currently, the overall government expenditure on social infrastructure has declined due to economic recession, and a substantial amount of tax revenue being used to service debt repayment, thereby limiting resources for healthcare facilities development, as explained in Chapter Three. As a result, the client institution has emerged as the principal player in healthcare facility projects.

Investment in healthcare facility projects is generally viewed by the institution from an entirely different perspective from that of the design and the construction teams. Hence, the healthcare institution defines the end-product in terms of return on investment. The objectives of the client generally relate to fulfilment of capacity efficiency issues. Achievement of these objectives relates almost exclusively to maximisation of profit with minimum financial outlay and risks. Thus, the evolution of the project brief, design solutions, construction systems relating to security on the investments now frequently supersedes the functional requirements of the patients, caregivers and family. And hence the DGAEF focus primarily on area and cost with no general or specific requirements on the quality of the physical environment.

From the above analysis, it is evident that healthcare institutions are operating in a system that can significantly compromise and impact on the quality of A&E facility buildings and operations. Indeed, the above issues are seen as weaknesses (see Table 8.8); and it is concluded that moral and ethical dilemmas always emerge owing to misunderstanding between the client, design and construction team regarding the stated vision of the institution

Thus, the key recommendations (principles) in this regard are:

(1) DGAEF should focus on patient/caregiver/family/visitor-focused project vision/ goals.

(2) Incorporate evaluation tools (DQIs/KPIs) to assist in analysing the information concerning the opinion and vision of the client in relation to accessibility; management; quality of services delivery; procurement systems and for measuring the experience of the users in the DGAEF.

Providing these evaluation tools in the DGAEF can address problems relating to poor choice of materials and finishes, as this study argues that the quality of materials relates to the celebration of the practical and sensual dimensions of the space design and provision.

(3) Develop and introduce in the DGAEF evaluation tools for ensuring that stated measurable outcomes on these key perspectives: equity in distribution of resources; accessibility of healthcare facilities; design and built quality of the product; functional suitability and spatial relationships; predictability of time; predictability of cost and return on investment.

9.3.6 DGAEF as a tool for standardisation of project development process

Standardisation of the project development process is dependent on the information systems in the DGAEF. This study has shown the marginal role played by standardisation of the design tools used for space design and provision in South Africa, which is seen as one of the major weaknesses in the DGAEF (see Tables 8.9).

Indeed, standardisation relates to an agreed framework, developed through research, in the DGAEF for decision making tools for project briefing, design and construction such as:

space design and provision, space dimensions, space room data requirement, space engineering services needs, space materials and space equipment, furniture requirements and space construction systems.

However, there is caution expressed by the stakeholders in acceptance of the current interest in the use of this concept and its introduction in the DGAEF. This study reveals that there is a major concern among architects about providing standard information systems in the DGAEF used for the overall project development process, who argue that it will constrain innovation.[164] Caregivers similarly caution about using standard information, as the use of a compulsory rigid template for project briefing tools may be outdated owing to constant change in the A&E facilities environment. Indeed, introducing this concept in the DGAEF may fail to keep up with today's technology innovation in medicine and design. All these issues are seen as weaknesses and threats to the use of standard tools for healthcare facility projects (see Table 8.9)

On the other hand, it is argued that standardisation of the information in the DGAEF used for the project development of A&E facilities is necessary to reduce excessive project completion programmes and cost overruns. Hence, standardisation is seen as having strengths and presenting opportunities, as the SWOT analyses in Table 8.9shows.

Thus the recommendations (principles) put forward are as follows:

(1) Provide generic design tools in the DGAEF to facilitate the use of standard tools that are easily modifiable to suit local contexts and needs.

(2) Create an interest in standardisation of the whole project development process in order to improve on three key variables—quality of the finished product, time and cost—owing to the dissatisfaction of healthcare institutions in the way these facilities are delivered.

(3) Apply standardisation to all caregiver’s operational areas in the A&E facility to

[164] See Chapters Two, Four, Five, Six and Seven.

improve workflow process efficiency and resources availability by reducing the time spent hunting and gathering during operations.

(4) Standardise the integration of engineering services provided in the headwall design. The standardisation of the location of medical gases, power outlets and monitoring equipment on the headwall in all rooms was shown in this study to reduce confusion among caregivers who serve patients in multiple rooms.[165]

(5) Standardise all patient rooms so that they are identical in design, with every element located and oriented identically, in order to reduce hunting and gathering tasks which significantly affect caregivers' time.[166]

9.3.7 Perceptions and barriers limiting compliance and the future of DGAEF

Using the recommendations outlined above as a point of departure for the DGAEF update, improvement in the quality of A&E physical environment is unlikely without addressing perceptions and barriers related to compliance to the design tools in the DGAEF; lack of research-based KPIs; lack of tools for POE developed through research; shortage of skills; lack of demonstration projects; attitude and behaviour of stakeholders; and poor research culture in the field.

Therefore, it is recommended that an integrated management body for the whole project development process is constituted for healthcare system services in order to view the problem holistically. The new statutory body should be responsible for developing generic DGAEF, cost planning models and control systems to ensure that cost limits set during the project briefing stage are adhered to. All design tools in the DGAEF must have KPIs and be updated regularly.

It is further recommended that the impact of constantly changing society needs on the healthcare system environment are assessed through demonstration projects and data collected

[165] See Chapters Two, Three and Six

[166] See Chapters Two, Three and Six

and kept by the central body and used for renovation and new work. In addition, each project should generate new data through KPIs and POE which should be collected centrally and used for update of the DGAEF used for space design and provision, functional suitability and spatial relationships.

To ensure effective resources planning and distribution, capital and operating costs should not be channelled through the provincial government. Currently, within this sphere of government, there is absolute lack of qualified human resources for their efficient and effective management.[167] To co-ordinate effectively, both capital and running funds should be channelled through the new body responsible for healthcare system services. This will provide the incentive for efficient and effective macro and micro planning and facilitate closer liaison with all user departments in developing and ensuring that healthcare systems strategic policies are implemented. This study has shown that this approach should allow scope for more innovative planning, improved healthcare facilities and service delivery in all local communities and provinces.

9.4 Practical implications

A new approach to DGAEF is needed which is based on co-ordinated resource use for project development processes. A key finding and recommendation of this research for government and policy makers is that the statutory application of the current planning unit, area and cost norms in the DGAEF should be discontinued. The DGAEF should be reviewed based on whole-life-cycle costs in order to improve A&E healthcare facilities physical environment in South Africa.

Therefore, the strategic/operational implications of this study are as follows:

(1) *Establish a healthcare facility project development council*: This body should be responsible for developing and updating the DGAEF based on the information

[167] See Chapter Three and Five.

obtained from the research institute for healthcare facilities proposed below. The proposed new body should develop general and specific DGAEF for the integration of the strategic and project briefing process, design and construction into one process to address the key issues of quality, time and cost. The proposed new DGAEF developed in accordance with the recommendations outlined above should be adapted taking into account geographical, political, social, cultural, economic and sustainability perspectives.

(2) *Establish a research institute for healthcare facility architecture*: The proposed research institute membership should be drawn widely, taking in the healthcare systems services, healthcare facility design team, caregivers, patients, academics, government and community members. The proposed new body should be responsible for developing interdisciplinary research directions for healthcare facility environments. In particular, it should develop a research plan based on areas of priorities for general and specific requirements in the DGAEF; for example, collection of statistical data for space programming, operational space design and provision, space functional suitability and spatial relationships; and other pertinent information for the project development process, including developing KPIs for evaluating information systems introduced in the DGAEF update.

9.5 Limitations on the research

A major accomplishment of this study was to provide grounds for future research in DGAEF used for space design and provision for A&E facilities, which are more likely to be based on mixed research methodology (see Chapter Four). The research encountered new challenges in the study of the A&E physical environment, but concerted efforts were made to overcome them and limit their effect. Nevertheless, the study was constrained by the limitations summarised below and explained in more detail in Chapter Four: 4.8.

(1) *Government reshuffling*: The timing of the empirical study coincided with the Gauteng Provincial Government cabinet reshuffling. Therefore, some of the heads of departments and chief directors from the Departments of Health and Public Works had to cancel or reschedule their appointment.

(2) *Social and contextual issues*: Most participants in the patient category are people living in informal settlements without basic urban planning design guidelines and social infrastructure. Therefore, conducting research in this environment was found to be very challenging.

(3) *Conducting research in A&E physical environment*: The operations in A&E facilities in South Africa have a strong primary healthcare system function with 24-hour, 7-day access. Therefore, conducting the surveys and observational studies in this environment was found to be very challenging.

(4) Obtaining permission for photographic documentation: Permission was not granted to the researcher to take photographs at Pretoria Academic Hospital. Indeed, most healthcare institutions do not grant permission to use photographic and video cameras owing to the personal and sensitive nature of healthcare services delivery, and legal and ethical issues (see 2.7.5).

(5) *Research programme and financial resources*: The study programme was based on the time and limited financial resources granted by the researcher's firm. The study scope was limited to the influence of the DGAEF on A&E facilities: other departments in the healthcare facility environment were not considered due to limited time and finances.

9.6 Future research

This study has identified many challenges that are evident in the DGAEF application systems related to space programming, area and cost. These problems are now leading to a situation where design professionals are debating the relevance and efficacy of the design tools in the DGAEF. In this regard, the key issues that have emerged from the findings of this study that are suggested as topics for future research are the following:

(1) *Design and operational systems-based perspectives*: This study argues that the DGs used for space design and provision, functional suitability and spatial relationships lack sufficient general and specific requirements for the integration between people, space, processes and technology. Thus, this research argues the need for further studies on current trends in the use of design and operational systems-based perspectives for the development of healthcare facilities by interdisciplinary project teams. It is important to address the shift from old habits to a new system of processes, technologies and workflow processes as early as possible. The knowledge gained from this study, suggests that this research could be based on theoretical and empirical bases and could address the key dimensions, sub-dimensions, findings and recommendations concerning DGs for design and operational systems-based perspectives for the development of healthcare facilities.

(2) *Standardisation of A&E operational spaces*: The A&E operational spaces are all about regularity and repetition of shape, size and proportion of design and construction elements applicable to spaces that can be unique to a healthcare facility environment. Standardisation is a broad concept and the term has been used in various ways in the healthcare industry. It is not a commonly studied concept; hence, there is very little information available in the literature. Therefore, this study suggests that standardisation of the A&E operational spaces and its influence on workflow processes should be studied. The main aim of the study would be to assess options for improvement of operational issues pertaining to the key factors affecting caregivers' time in A&E spaces through standardised design of spaces. This study may lead to improved capacity efficiency issues and A&E facility throughput.

(3) *Environmentally responsible design*: At present the design tools in the DGAEF for the

project development process provide little information relating to the design of spaces for healthcare facility that are environmentally responsible. This study recommends future research that will encourage the introduction of KPIs for environmentally responsible design tools in the DGAEF used for project development process. The topic can investigate the importance of DGAEF on resource use awareness which is essential to the reduction of the carbon dioxide footprint in the environment as well as reduction of water and energy consumption during and after construction. The research could also address the need for benchmarking tools for evaluation of sustainability issues to be developed and introduced in the DGAEF.

(4) *Human resources need for healthcare facility project development*: This study reveals that skills shortages in this field can lead to miscommunication between the client and the design team. Very few tertiary institutions offer degree courses on healthcare facilities design in South Africa. Thus, the few that do should address how training on new approaches for DGs development for A&E facilities can be investigated in future research. The knowledge acquired from this study could be used to develop a theoretical and empirical approach for the proposed study, which would recommend new approaches to training in DGs and associated areas in architecture.

9.7 Approaches to generalization of the research findings

The Planetree principles are the philosophical, theoretical and conceptual background used for this study since people associate places with therapeutic potentials depending on the quality of the design tools in the DGs used for space design and provision. Planetree principles focus on the theory that nature heals. The logic of this argument is a follows: nature is multidimensional in character (physical, mental, spiritual, emotional and social); nature possess wholeness and connectedness or integration; nature can heal from within; nature influences ongoing process with the meaning in one’s everyday life as healing is humanistic and as such depends on the quality of the physical environment (Frampton and Charmel, 2009; Lindheim, 1985).

From the findings of this study, DGs can influence the following four healthcare facilities environmental factors that can contribute to a healing sense of a place: natural; built, social and symbolic. The ideas that lie behind this claim are that the findings and recommendations from this study can be applied in A&E facilities in other provinces in South Africa. Thus, there are various possibilities to generalise the research approach, findings and recommendations of the study in other countries with similar geographical, social, political, cultural, economic circumstances and project development processes. Nevertheless, findings related to the effectiveness and efficiency of the use of resources cannot be generalised owing to the specificity of needs, A&E cases classification methods, DGs systems and applications, unpredictability of patient inflow, and operational systems.

However, owing to different funding systems for public sector healthcare facilities in other countries and available resources for government expenditure on social infrastructure, generalisation in terms of DGAEF as a means for institutional transformation must be treated with caution.

9.8 The significance of the study and its contribution to knowledge

The findings and recommendations from different stages of this study have made a significant contribution to knowledge and understanding of DGAEF, and in particular, those currently used in South Africa. The significance of the study and its contribution to knowledge are summarised as follows:

(1) The findings and conclusions from this study fill gaps in the literature on DGAEF concerning how they are formulated and developed; the management and efficiency of the project development process; the operational environment; the institution; and communication strategies and information systems. The key dimensions and sub-

dimensions affecting the current status and shape, and the perceptions and barriers limiting compliance to the use of DGAEF have also been explained. Furthermore, the strengths and weaknesses, opportunities and threats to the use of DGAEF have also been identified in this study. Thus, it is believed that the findings and recommendations from the research add to the existing body of knowledge on DGAEF used for space design and provision and lessons learned from practice; and also raise key questions which require further research.

(2) The conclusions from this research provide important guiding principles for government and decision makers involved in the development of the healthcare facilities in South Africa, for the update of the DGAEF used for space design and provision, functional suitability and spatial relationships. The knowledge gained from this study provides more insight into A&E healthcare facilities development so that more effective and efficient project development processes can be used in the future. In addition, the findings provide an empirical basis for addressing the major challenges constraining the social model of healthcare system policy objectives—equity, efficiency, effectiveness and responsiveness.

(3) The data and information gathered through this study can be utilised for future research; and the research methodology can be used for similar studies on DGAEF in other provinces of South Africa and in other developing countries with similar contextual backgrounds.

(4) The study has raised the need to develop and introduce KPIs in the DGAEF for the concept of design and operational systems-based perspectives to improve integration between people, space, processes and technology. This new concept is targeted at specific goals that will be applied consistently across the project development process in order to ensure coordination across all operational systems in A&E zones A, B, C and D. This study could open a new area in research concerning DGAEF. Indeed, the

implications of the use of this concept is that the interdisciplinary project team stay informed and understand the operational changes occurring during the overall project development phases, so as to be able to integrate the operational changes in strategic and project briefing, design, construction, operations and maintenance as appropriate.

9.9 Reflections on the knowledge gained from the research

Designing within a box no longer delivers the comprehensive results needed to improve the quality of the healthcare physical environment. In fact, this study reveals that to ensure that good results are achieved in healthcare facility project development, benchmarking tools in the DGAEF for design and operational systems-based perspectives should be used to coordinate planning between the operational system, the design and sub-project team members, and the construction firm. Currently, as shown in this study, the majority of design decisions are made expeditiously based on previous experience with similar situations, familiar materials and known technologies.

This study has revealed that rational decision making based on DGs for space design and provision is the logical outcome of a systematic research process. However, evidence applied to one situation may have entirely different implications in another context. Hence, the KPIs in the DGs used for space design and provision should be context specific. The data used for space programming should, therefore, relate to the geographical, political, economic, social and cultural circumstances of the context where the healthcare facility is situated.

This study reveals that most design professionals are calling for the introduction of performance benchmarking tools rather than prescriptive DGs. The latter focus on the use of quantitative variables, like minimum and maximum areas for a room and cost norms. The evidence from the two case studies shows that caregivers can perform their function of care to patients within the space provided. While the empirical based evidence is quite acceptable on these issues, is the recommendation correct? How big should the room be? Is it all about size?

Indeed, the physical environment around us can set our mood, and also create challenges and barriers. Thus, the DGs should provide benchmarking tools for assessing the impact of the healthcare environment on users: patients, caregivers, family members and others. Performance benchmarking tools describe measures of desired performance, and the design team and healthcare institution have flexibility in choice of the space design solution based on users' needs. Minimum or maximum areas need not be set as the project team and healthcare institution have the flexibility to decide based on the actual need determined through the information obtained from design and operational systems-based perspectives.

This study tells us that we need to carefully examine our decision making through the information and knowledge systems in the DGAEF using the full power of both our rational and emotional capabilities. For example, a community healthcare facility may have limited human and other resources to meet the minimum area requirements for patient rooms as recommended in DGs for healthcare facilities, which might be necessary at a city healthcare facility. In practice we have seen in this study that the A&E patient room's space design should be flexible and adaptable in order to accommodate evolving need. But the general and specific requirements in the DGAEF have yet to be changed.

This study has shown that the design professionals scored poorly on level of awareness of the implications relating to geographical, political, social, economic and cultural issues contained in the DGs used to make decisions. They consequently often resist imposed or prescriptive regulations. This strong desire for freedom to design indicates that healthcare design professionals are not ready for rigid or restrictive or prescriptive DGs and their continuous use may never encourage compliance.

In conclusion, it is revealed in this study that access to information and knowledge systems and awareness of the importance of DGAEF by the design professionals should improve A&E facilities design and poor results obtained in the KPIs used for measuring the healthcare systems of equity, efficiency, effectiveness and responsiveness.

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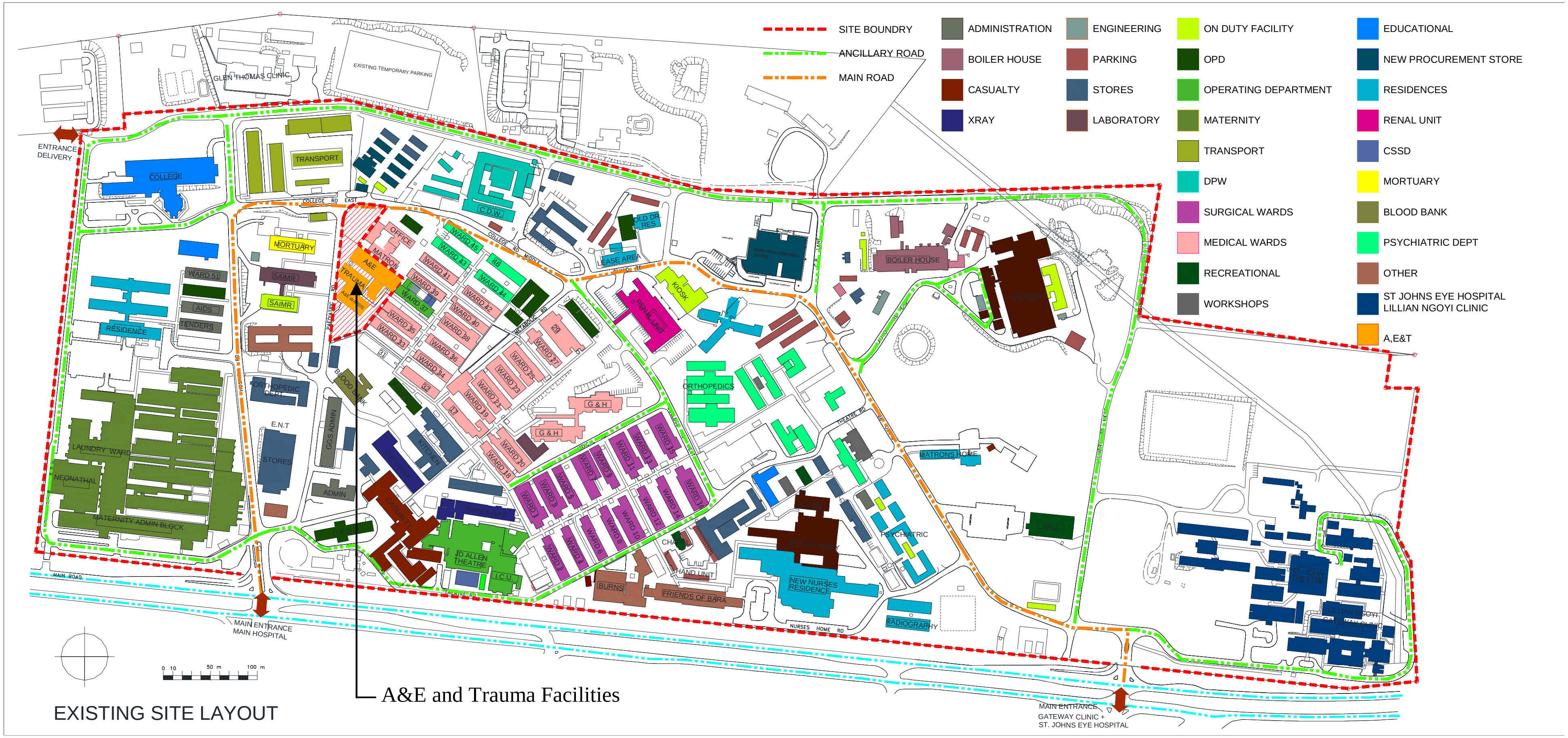
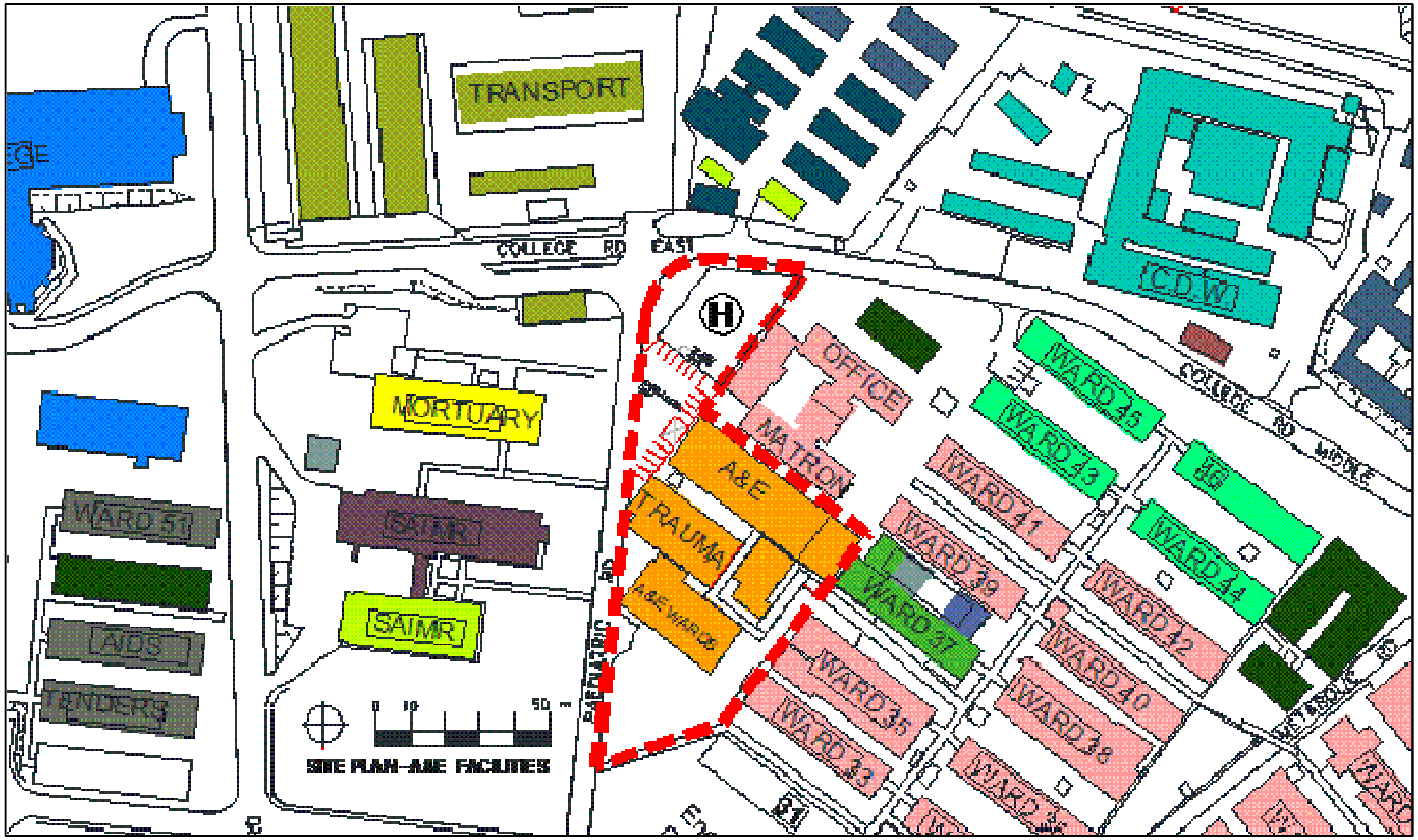
Appendix A: Existing site layout and photographic survey at CHBH A&E facility



Appendix A: Existing site layout and photographic survey at CHBH A&E facility



Site layout: CHBH A&E and Trauma facilities

ZONE A- Entrances, Waiting and pre-examination areas

1. Main entrance

2. Waiting area

Entrances, waiting and pre-examination areas: The locations of the two main entrances for ambulatory and recumbent patients, staff and visitors are physically separated from the reception and admission counters. The general observed atmosphere reigning at the department entrances is untidy and unwelcoming, this is the trend in most A&E facilities in Gauteng Province. In general, caregivers, patients and visitors are not comfortable with the overall atmosphere of the entrance area. A noisy and disorderly environment with occasional interaction with staff members was the mood during observed at the waiting areas. The result of the unpleasant physical environment and ambience is that most patients and visitors prefer to use the ad hoc waiting area outside the facility, which is less crowded and less bad smelling, despite the external climatic conditions. The absence of triage and pre-examination areas in this unit is evident and due to lack of spaces it is very difficult to handle the expected daily attendance and it may be even more uncomfortable to adjust to by the caregivers. The following important areas are also lacking at CHBH A&E facility: there is no provision made for porter's area; trolley and wheelchairs park area are outside the entrance area: there is inadequate space for storing and cleaning trolleys and wheelchairs.

3. Assessment area

4. Trolley park area

5. Wheelchair park area

ZONE B- Examination and Treatment Areas

1. Duty room entrance door

2. Examination area

Examination and treatment cubicles: The observation revealed that owing to limited number of examination and treatment spaces the caregivers at CHBH A&E facility were forced to follow unbroken sequence of consultation, examination and in some cases also treatment of the patient are done at the same time in the same room. The current CHBH A&E unit was not planned based on the concept of acuity-adaptable or "universal" patient examination and treatment rooms. Lack of clinical spaces forced management to change their A&E work culture for efficient utilization of all resources including staff, equipment and space in order to handle the daily patient population to this department. The result of this observation confirms that design of the examination and treatment spaces can be flexible space adaptable over time to accommodation shifts in A&E work processes and fluctuating utilisation can reduce long-term renovation costs. To facilitate flexibility and efficient management, all the rooms should have direct access to storage areas. The design form and floor layout of the A&E department can reduce to absolute minimum the caregivers walking distances from their workstations to the consultation, examination, treatment and to the ancillary areas.

3. Nurses and physicians area inside the examination room

4. Multi-use space examination and treatment area

5. Examination and treatment area

ZONE B- Examination and Treatment Areas

6. Multi-use cubicle examination and treatment area 	**Examination and treatment cubicles:** One of the most taxing problems for patients and caregivers is trying to maintain privacy and dignity in the current floor layout configuration of the CHBH A&E department. In fact, in any open general examination/treatment cubicles where visual and auditory separation is gained with curtains, the level of privacy and dignity experienced by the patients and caregivers are usually of low quality. Indeed, any clinical intervention and any action on the part of the patient or caregivers can be overhead by anyone in the vicinity. In CHBH A&E the issues regarding visual and auditory privacy is even more compromised due to the location of the waiting areas directly opposite and adjacent to the minor and major examination/treatment spaces. The result of this investigation have shown that privacy and dignity is essential in these spaces and this implies that walls and doors may provide an adequate level of sound-proof between adjacent spaces and also between rooms and waiting areas. This investigation revealed that the spatial arrangement and room dimensions although according to the current DGAEF their spatial relationships does not support effective and efficient working environment for the caregivers thereby constraining quality healthcare services delivery to the patients.
7. Caregivers rest area 	8. Multi-use space examination and treatment area 
9. Multi-use space examination and treatment area 	10. Examination and treatment area 

1. Clinical observation room

2. In-patient treatment area

Clinical observation unit: The location of the nursing station is physically distant from the ward area compromising observation of the patient. Its location is inappropriate for the observation of the patients which is an important issue particularly in this area, people entering the unit through main entrance should be easily seen from this position by the caregivers. The location of the counter is inappropriate for surveillance of this unit thus compromising the issue of security and safety of the patient. The entrance door to the clinical observation unit is located next to the nursing station due to lack of space there is no entrance or wind lobby in this area. The floor layout plan configured into five patient zones each accommodating six-bed cluster but without an en-suite facility and mini work station. There is only one wash-hand basin for each six-bed cluster. The space in each patient core area is 2400 mm (width) x 2600 mm (length): this width is not adequate to accommodate bed measuring 1060 mm (width) x 2335 mm (length) without orthopaedic attachments. Indeed, it critical that the design of the floor plan layout address issues such as: accessibility; patient safety; capacity efficiency; medical errors; wayfinding and positive distractions.

CHBH A&E clinical observation unit requires re-designing to improve interaction and communication amongst caregivers/ patient.

3. In-patient area

4. Clinical observation room

5. Clinical observation room

ZONE D- Support and Ancillary areas

1. Corridor area

2. Medicine storage area

3. Caregivers locker room

4. Supplies store

4. Supplies store

5. Dirty utility room

ZONE D- Support and Ancillary areas

6. Patient ablutions sink

7. Stationery store

Ancillary and support areas: The caregiver's rest area and change rooms with ablution facilities provided at CHBH A&E facility are inappropriate and insufficient based on the staff population. The space design, provision and location of these areas are poorly articulated, the rest area has no direct access to the pantry and they are located off the same corridor used by the patients and the visitors. Ideally the rest area should be designed so that the caregivers wishing to read or talk is not disturbed by the noise from the adjacent corridor or from TV. The design of the ancillary and support areas are as recommended by the client and the design team; owing to the little information regarding this area in the current DGAEF, the minimum recommended storage space size is 8 m^2 their location and required numbers are determined by the design team. In addition, equipment, linen, consumable stores, medical waste and housekeeper's room were only provided and they are all located off the main A&E facility corridor. These stores are designed and positioned in accordance with the information obtained from the healthcare institution; indeed their numbers and position are not according to A&E operational process requirements.

8. Storage space

9. Examination and clinical observation room linen store

10. Storeroom

Appendix B: SAHNorms

SUMMARY OF REVISED (OCTOBER 1987) NEED NORMS AND GUIDELINES FOR THE CULCULATIONOF PLANNING UNITS FOR COMMUNITY HEALTH CENTERSAND COMMUNITY AND REGIONAL HOSPITALS

	Department or Facilitiy	Planning Unit (P.U.)	Need norm	Area norm m² groos/P.U.	Cost norm R/P.U. December '79
1	Preventive Service				
1.1	General Diagnostic and Treatment Room	Examination Room	1 Visit per capita per annum @ 60 visit per day per examination room. (Example: 10 000 population ÷ 60 patients per day per room = 0,66 p.u.)	60 m²	13 200
			NOTE: TO BE PROVIDED IN PROVINCIAL AUTHORITY C.H.C.		
2	Provincial Authority		NOTE: SIZE OF C.H.C. POPULATION CUT OFF POINTS		
	Community Health Center (Curative Service)		C.H.C. 5 - 7 500		
			C.H.C. 10 7 501 - 12 500		
			C.H.C. 15 12 501 - 17 500		
			C.H.C. 20 17 501 - 30 500		
			C.H.C. 40 30 501 - 50 500		
			C.H.C. 60 50 501 +		
2.1	General Diagnostic and Treatment Room	Examination Room	2 Visits per capita per annum @ 40 visits per day per examination room if used by doctor.		
			2 Visits per capita per annum @ 20 visits per day per examination room if used by nurse.	60 m²	13 200
			(Example: 10 000 population × 2 ÷ 250 = 80 visits per day		
			Deduct 40 visits per day of doctor 40 (1 P.U.)		
			40		
			Nurses: visits/days × 2 -40 (2 P.U.)		
2.2	Midwife Obstetric Unit (MOU)	Obstetric Bed	0.18 Obstetric beds/ 1 000 population (40 deliveries/1 000 of Black population)	40 m²	10 300
			(Example for 20 000 population : $\frac{20\ 000}{1\ 000}$ × 0, 18 = 3, 6 p.u.		
2.3	X. Ray Diagnostic Service	X-Ray Room	Popolation < 30 000	40 m²	11 000
			Popolation > 30 000	80 m²	22 000
2.4	Minor Operating Suuite	Operating Room	1 Operating room per 60 000 - 100 000 population	100 m²	34 000
2.5	Day Nursing Ur	Day bed	Motivate (Provide 1 Day bed per 10 000 population	12 m²	2 600
2.6	Physical Medicine Services	Therapist	Motivate on basis of appointed Therapists. (As a guide provide 1 P.U. per 60 000 - 100 000 population)	115 m²	28 000
2.7	Dental Services	Dental chair	Popolation < 25 000 : 1 P.U./25 000	60 m²	15 000
			Popolation > 25 000 : 1 Examination Room	60 m²	13 200

	Department or Facilitiy	Planning Unit (P.U.)	Need norm	Area norm m² groos/P.U.
2.8	Other		Motivate	
2.8.1	Phototherapy	Room	To be provided with MOU	20 m²
2.8.2	Social Worker	Room	Motivate	12 m²
7	Nursing Units		(1) Age and sex distribution is important in determining the need for Obstetric, Paediatric beds.	
			(2) Caculate the total number of beds as follows: 1.5 beds per 1 000 population. (Note: The number of bed required may also be expressed according to the percentage bed occupancy (oorbesetting) based on the planned patient-bound continuous use beds).	
			(3) Patient- bound continuous use beds are the following: Normal beds, ICU, crib (cot), incubator, admission/discharge bed.	
			(4) Patient-bound temporary use beds are the following: Recovery, observation, dailysis, delivery,haematology/oncology, resuscitation bed, sit bed. Note: THESE BEDS MUST BE INDICATED UNDER PARAGRAPH 2.5 (DAY BEDS).	
7.1	General	Bed	66% of the total number of bed e.g. ($\frac{66}{100} \times \frac{1,5}{1\ 000} \times$ Population)	Up to 24 (single, 4 and 6 bed units)
				Up to 18 (single, 8 bed
7.2	Maternity			
7.2.1	Nursing unit	Bed	10% of the total number of beds e.g. ($\frac{10}{100} \times \frac{1,5}{1\ 000} \times$ Population)	Up to 26 (single, 4 and 6 bed units)
			NOTE: ALSO CHECK NO. OF BEDS ACCORDING TO THE FOLLOWING FORMULA: 0,18 OBSTETRIC BEDS PER 1 000 POPULATION. ALSO TAKE INTO ACCOUNT THE ACTUAL NUMBER OF BIRTHS WHERE HOSPITAL EXISTS. (GUIDE: 40 BIRTHS/1 000 OF BLACK POPULATION)	
				Up to 20 (single, 8 bed and large units)
7.2.2	Delivery Unit	Delivery Room	Provite 1 delivery room per 8 obstetric beds	1 d.r. = 200 2 d.r. = 140 3 d.r. Or more = 120

	Department or Facilitiy	Planning Unit (P.U.)	Need norm	Area norm m² groos/P.U.	Cost norm R/P.U. December '79
7.3	Paediatric unit	Bed	24% of the total number of beds e.g. $\left(\frac{24}{100} \times \frac{1,5}{1\,000} \times \text{Population} \right)$ NOTE: PAEDIATRIC REFERS TO CHILDREN UNDER 13 YEARS OF AGE	19 -25	8 300
7.4	Acute Psychiatric	Bed		19 - 25	8 300
7.5	Intensive Therapy	Bed	Intensive therary bed should not exceed 4, 5 per cent of the total general acute bed in the hospital or group of hospitals.	40 (6 - 8 bed units)	16 400
7.6	Highly specialized	Bed	Highly specialized beds are to be provided on the following national basis overriding Provincial Boundaries: One liver transplant unit: 15 million population One heart transplant unit: 15 million population	Motivate	Motivate
8	Outpatients		NOTE: FOR EXISTING HOSPITALS USE ACTUAL NUMBER OF VISITS TO CALCULATE THE PLANNING UNITS. FOR NEW HOSPITALS USE THE FOLLOWING FORMULA TO CALCULATE THE TOTAL NUMBER OF VISITS PER ANNUM: POPULATION X 2 = NO. OF VISITS.		
8.1	General and specialist examination and treatment	Examination Room	(a) General : 50% of visits per annum ÷ 10 000 = No. of P.U.	60	19 200
			(b) General specialist: 50% of visits per annum ÷ 5 000 = No. of P.U.	60	19 200
8.2	Specialist examination and treatment requiring specially designed and dedicated space (i.e. Eye and Audiomentry Clinics, Dentistry etc.)	Examination Room	Motivate	60	Motivate
9	Emergency	Patients in 3 hour peak period	(a) Determine the likely number of emergency patients in a three hour peak period. (b) Use the out-patien norm where the number of patients is less than 60 during a 3 hour period.	430 m² /60 patients plus 100m² for every additional 50 patients	R378/m²
10	Dispensary	Bed		0,8	230

	Department or Facilitiy	Planning Unit (P.U.)	Need norm	Area norm m² groos/P.U.	Cost norm R/P.U. December '79
11	X-Ray (Diagnostic only)	Examination Room	1 Examination room per 350 X-Ray procedures per month where more than one P.U. is required. Alternatively provide 1 P.U. per 18 00 population, with a minimum of one per hospital.	100 - 160	51 000
12	Operating Department	Department room	(a) 1 P.U. is based on number of operation per day year divided by 1 387. The factor 1 387 is based on the following formula: $\frac{8 \text{ hours per day}}{1{,}5 \text{ hours per operation}} \times \frac{5 \text{ days}}{1} \times \frac{52 \text{ weeks}}{1}$ (b) Motivate any dedicated theatres to be provided: e.g. cardiology, ophthalmology, orthopaedic surgery. Alternatively provide 1 O.R. for every 30 - 40 surgical beds.	180	76 500
13	Administration	Work place	(a) Basic units: Total number of beds multiplied by 0,12 = number of work places. (b) Add the following additional units: (i) Reception officers)) Total ÷ 4 shifts = No. of work places (ii) Security officers) © Also provide work places for the following: (i) Ministers (only minimum number of work stations to be provided - thes people work primarily in wards). (ii) Social workers (calculate the number of social workers to be employed). a + b + c = No. of work stations to be provided. <u>Note:</u> (i) Work places for supplies and inventory control are included in norm for stores. (ii) Messengers in registry do not require work places. (iii) Area for duplicating rooms included in norm for administration. (iv) Areas for cleaners, tea servery, cafeteria and porters included in norm for administration.	26	7 300

	Department or Facilitiy	Planning Unit (P.U.)	Need norm		Area norm m² groos/P.U.	Cost norm R/P.U. December '79
14	Central Sterilizing and Supply Department (CSSD)	Depatment	Calculate the volume of packs in m³ per week to be sterilized on the following basis:	volume of packs m³/week		
			For normal hospital use allow 0,012m³ per bed per week in a Community Hospital for all department s excluding theaters and delivery rooms. For theaters in operating department and emergency and delivery rooms allow 1,2 m³ per operating theatre or delivery room per week.	up to 5	150*	R400/m**
				6 to 7	175 plus 4m² for each additional m³ above 6m³	
			* minimum size department = 150 m² gross ** the cost of sterilizing equipment is included	18 -29	235 plus 6m² for each additional m³ above 18 m³	
				30 -39	320 plus 7m² for each additional m³ and above 30 m³	
				40 -50	405 plus 7m² for each additional m³ and above 40 m³	
15	Laboratory	Department	Motive NOTE: SCHEDULE OF ACCOMODATION IS REQUIRED FOR SUBMISSSION TO DEPARTMENT OF HEALTH AND POPULATION DEVELOPMENT		R305/m²	

	Department or Facilitiy	Planning Unit (P.U.)	Need norm		Area norm m² groos/P.U.	Cost norm R/P.U. December '79
16	Kitchen	Meals	The number of meals that is prepared for midday in the kitchenis based on the following:	Number of P.U.	m²/P.U.	
			(a) Smaller hospitals without a nurses residence	-100	1, 70	620
			- total number of beds	101 - 250	1, 45	530
			- 100% of full time medical personnel	251 - 500	1, 23	455
			- 72% of the nursing establishment	501 - 750	1, 15	420
			- 100% of the administrative and auxiliary personnel	751 - 1 000	1, 05	385
			- 87% of the total complement of labourers and domestic servants provided everyone get food from the kitchen	1 001 - 1 500	1, 00	364
			(b) Large hospitals with a nurses'residence			
			- total number of beds			
			- 80% of the total complement of full-time medical personnel			
			- 100% of resident nurses if no kitchen is provided in the nurses'residence.			
			- 72% of all non-resident nurses			
			- 92% of the administrative and auxiliary Personnel			
			- 87% of the total complement of labourers and domestic servants provided everyone get food from the kitchen			
17	Dining	Diner	The number of diners to be accommodated in the dining hall at any one sitting of the midday meal is based on the following	-10	2, 0	470
			(a) Smaller hospitals without a nurses residence	11 - 20	1,8	425
			- 100% of full time medical personnel	21 - 30	1,7	400
			- 36% of the nursing establishment	31 - 50	1, 6	375
			- 100% of the administrative and auxiliary personnel	51 - 75	1, 5	355
			(b) Large hospitals with a nurses'residence	76 - 100	1, 4	330
			- 40% of the total complement of full-time medical personnel	101 - 150	1, 3	305
			- 50% of the total number resident nurses if no provision has been made in the nurses'residence duning room.	151 - 200	1, 2	285
			- 36% of the non-resident nurses	201 - 300	1, 15	270
			- 92% of the administrative and auxiliary Personnel	301 - 400+	1,1	260
18	Mortuary	Body			8	3 400
19	Stores	Beds	For small hospitals estimate area of stores on the basis of 2 m² per P.U.		1, 5 - 2, 0	520

	Department or Facilitiy	Planning Unit (P.U.)	Need norm		Area norm m² groos/P.U.	Cost norm R/P.U. December '79
20	Physiotherapy Department	Physiotherapy	Estimate the number of full time Physiotherapists for the department.	1	160	43 500
				2 - 7	115	35 200
21	Occupational Therapy Department	Occupational Therapist	Estimate the number of full time Occupational Therapists for the department.	1	160	43 500
				2 - 7	115	35 200
22	Special facilities	m²	Motivate for special facilities such as Radiotherapy, Nuclear Medine, Clinical Biometry, Bloodbank, etc.	Motive -As a guide this should not exceed 3 m² /bed		305
				Number of beds.	m²/P.U.	
23	Workshop	Department	Estimate total number of beds served by workshops.			
			Some workshops are centralized for group of hospitals	100	175	44 000
				150	260	65 000
				200	350	88 000
				300	460	115 600
				400	520	130 700
				600	570	143 200
				800	600	150 800
24	Plant space	m²	The amount of plant space varies considerably depending upon factors such as the provision of air-conditioning.		As a guide this should generally not exceed 3m²/bed for hospital without air-conditioning	263
25	On duty facilities for living out staff					
25. 1	Domestic and labourer changed and dining	Staff members	Provision for the facilities for labourers is based on the following:			

Appendix C: Questionnaire for Consultants

Questionnaire for Architects, Quantity Surveyor, Civil, Structural, Electrical and Mechanical Engineers

No.	SN/B	50		Survey of the role of design guidelines (DGs) for Accident and Emergency Facilities (A&E) in South Africa

We would like to ask you to complete this questionnaire about your experience on the use of DGs for the development of A&E healthcare facilities in South Africa. Your answers are important and will assist the researcher in the update of the DGs for the design of A&E Facilities (DGAEF).

Department: …………………………	Date:……………………………..……

Section A: Personal Background Of Respondents

In this section, we would like to ask you a set of questions about your gender, age, experience, place of residence, qualifications, and marital status.

Question	Option	No.	Box	Code
Gender?	Male	1.		1
	Female			2
What is your age?	Years	2.		1
What is your home language?	English	3.		1
	Afrikaans			2
	Isixhosa			3
	Isizulu			4
	Sesotho			5
	Setswana			6
	Sepedi			7
	Seswati			8
	Tshivenda			9
	Zistonga			10
	Isindbele			11
	Other			12
Where do you reside?	City	4.		1
	Town			2
	Rural/Farm			3

Option	Box	Code
Under Secondary Certificate		2
Secondary Certificate		3
Diploma		4
University Degree		5
Other		6

Question	Answer	No.
What is your Professional Qualification?	……………………………………………	6
Are you a member of any professional body/bodies?	……………………………………………	7
What is your current position in this organisation?	……………………………………………	8
How long have you been in this position?	……………………………………………	9

Section B: Design Guidelines for A&E Facilities (DGAEF)

In this section you would be asked questions regarding the effects of general and specific design requirements in the DGAEF on efficiency and effectiveness of healthcare services delivery in the A&E facilities.

Question	Option	No.	Box	Code
Have you or a family member been to an A&E facility for medical treatment in the past 12 months? *(Tick the appropriate answer)*	Yes	10.		1
	No			2

Question	Option	No.	Box
If yes, which type of A&E healthcare facility did you or a family member go to? *(Tick the appropriate answer/s)*		11	
	Primary Healthcare Clinic	11a	
	District Hospital	11b	
	Provincial/ Regional Hospital	11c	
	Other	11d	

Which means of transport did you use to get to the A&E facility? *(Tick the appropriate answer)*

Walked	12.	☐	1
Own Car		☐	2
Other Private Car		☐	3
Bus		☐	4
Train		☐	5
Taxi		☐	6
Ambulance/Emergency Vehicles		☐	7

How far did you have to travel to get to the A&E facility? *(Tick the appropriate answer)*

Less than 5 km	13	☐	1
5km – 10 km		☐	2
10 km – 50 km		☐	3
More than 50 km		☐	4

What is your estimated travelling time to the nearest A&E facility? *(Tick the appropriate answer)*

Less than 30mins	14	☐	1
30 mins to 1 hr		☐	2
1 to 2 hrs		☐	3

If yes what was the average response time from logging the call? *(Tick the appropriate answer)*

0 – 15 mins	15	☐	1
15 mins – 30 mins		☐	2
30 mins to 1 hr		☐	3
1 to 2 hrs		☐	4

Are car park, taxi, bus stops and entrances easy to find and located close to the A&E building?

Yes	16	☐	1
No		☐	2

Are entrance approaches to surrounding areas welcoming and easy to find?

Yes	17	☐	1
No		☐	2

Are you familiar with the current DGAEF?

Yes	18	☐	1
No		☐	2

Do you have any further comments or opinions on this issue? 18.1

………………………………………………………………………………………………

………………………………………………………………………………………………

Have you used these DGs before for space design and provision of A&E facilities?

Yes	19	☐	1
No		☐	2

If yes, in what way? 19.1

………………………………………………………………………………………………

………………………………………………………………………………………………

What is the extent of compliance with the DGAEF amongst consultants? *(Tick the appropriate answer)*

Very High	20	☐	1
High		☐	2
Moderate		☐	3
Low		☐	4
Very Low		☐	5

Is the A&E facilities designed with the DGAEF adequate to providing quality healthcare services delivery?*(Tick the appropriate answer)*

Completely adequate	21.	☐	1
Adequate		☐	2
Undecided		☐	3
Inadequate		☐	4
Completely inadequate		☐	5

Do you have any further comments or opinions on this issue? 21.1

………………………………………………………………………………………………

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In your view would the introduction of a fast track area in the update of DGAEF improve efficiency in healthcare services delivery?

Yes	22	☐	1
No		☐	2

If your answer is yes in which area/s would you prefer it? *(Tick the appropriate answer/s)* 22.1

In admission Area	22.1a	☐
In Triage Area	22.1b	☐
At the Entrance	22.1c	☐
Examination Area	22.1d	☐
Next to Information Desk	22.1e	☐

In your opinion, are current maximum areas requirements in the DGAEF adequate? *(Tick the appropriate answer)*

	23.		
Completely adequate			1
Adequate			2
Undecided			3
Inadequate			4
Completely inadequate			5

Do you have any further comments or opinions on this issue? 23.1

……………………………………………………………………………………………

……………………………………………………………………………………………

What is the average current cost per square metre using the DGAEF?

	24		
Estimated cost per square metre			1
Do not know			2

Do you think it is sufficient to deliver adequate A&E facilities? *(Tick the appropriate answer)*

	25		
Completely adequate			1
Adequate			2
Undecided			3
Inadequate			4
Completely inadequate			5

Do you think that the budget allocations for A&E facilities are currently effectively spent? *(Tick the appropriate answer)*

	26		
Completely adequate			1
Adequate			2
Undecided			3
Inadequate			4
Completely inadequate			5

Do you have any further comments or opinions on this issue? 26.1

……………………………………………………………………………………………

……………………………………………………………………………………………

How long does it take to construct the following healthcare facilities from project briefing to completion? *(Give your answer in years/months)*

	27	Yrs	Mths	
Level 1 (District Hospital)				1
Level 2 (Regional Hospital)				2
Level 3 (Tertiary Hospital)				3

Do you think that this is an efficient and effective timeframe? *(Tick (v) the answer which corresponds to your view)*

	28		
Completely adequate			1
Adequate			2
Undecided			3
Inadequate			4
Completely inadequate			5

Do you think it is appropriate in relation to meeting the national need for A&E facilities? *(Tick (v) the answer which corresponds to your view)*

	29		
Completely adequate			1
Adequate			2
Undecided			3
Inadequate			4
Completely inadequate			5

Does the DGAEF used for space design allow for the provision of adequate facilities that would improve patient comfort in A&E facilities? *(Tick the appropriate answer)*

	30		
Completely adequate			1
Adequate			2
Undecided			3
Inadequate			4
Completely inadequate			5

Do you have any further comments or opinions on this issue? 30.1

……………………………………………………………………………………………

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Are you in favour of introducing standard project development tools for A&E facilities with provision for minor changes? *(Tick the appropriate answer)*

	31		
Completely adequate			1
Adequate			2
Undecided			3
Inadequate			4
Completely inadequate			5

Do you have any further comments or opinions on this issue? 31.1

……………………………………………………………………………………………

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In which of these areas do you think that introduction of "adaptable" and "flexible" standard project development tools would improve efficient and effective use of resources? *(Tick the appropriate answer/s)* 32

Examination Area	32a	
Stretchers Exam Area	32b	
Treatment Area	32c	
Resuscitation Area	32d	
Counselling Area	32e	
Triage Area	32f	

Do you have any further comments or opinions on this issue? 32.1

……………………………………………………………………………………………

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In your opinion would the use of technology (e.g. computer programmes, build information modelling and mock-ups) assist in the efficient and effective design of A&E facilities? 33

Yes		1
No		2

Do you have any further comments or opinions on this issue? 33.1

……………………………………………………………………………………………

……………………………………………………………………………………………

Please indicate in which of these A&E spaces you think the DGAEF need to be improved for more efficient use of A&E spaces? ***(Tick the appropriate answer/s)*** 34

Entrance	34a	
Reception	34b	
Waiting	34c	
Security	34d	
Triage	34e	
Ablutions	34f	
Information	34g	
Admission	34h	
Consulting/Exam	34i	
Counselling	34j	
Treatment/POP	34k	
Short Stay Ward	34l	
Duty/Staff Room	34m	
Nurses Station	34n	
Office Waiting	34o	
Administration	34p	

Indicate design quality indicators you believe need to be included in the DGAEF to improve efficiency and effectiveness of healthcare services delivery general and specific design requirements for A&E facilities? 35

……………………………………………………………………………………………

……………………………………………………………………………………………

Section C: The New Approach to DGAEF Update Based on Planetree Principles

In this section you would be asked questions regarding the influence of the DGs on the A&E facilities, healthcare services delivery culture, the society, and persons or users and also on the space design and provision functional suitability, space utilisation and spatial relationships.

In which of these areas do you think that the DGAEF used for space design and provision for A&E layout plan need to be improved to enhance interaction amongst staff, patient and family members? *(Tick the appropriate answer/s)* 36

Introduction of separate staff/patient corridors	36a	
Larger Examination Rooms	36b	
Introduction of Resource Centre/Library	36c	
Children Entertainment Area	36d	
Patient/Family Private waiting Area	36e	

Do you have any further comments or opinions on this issue? 36.1

……………………………………………………………………………………………

……………………………………………………………………………………………

Do you think that participatory approach in update of DGAEF will result in the design of a good healing physical environment? 37

Yes		1
No		2

If yes, who should participate? *(Tick the appropriate answer)*

	37.1	
National/Provincial Department of Health	37.1a	
National/Provincial Department of Public Works	37.1b	
Department of Social Services	37.1c	
Department of Education	37.1d	
Department of Finance	37.1e	
Professional Teams (Architects, Engineers, etc) Consultants	37.1f	
Construction Companies	37.1g	
Academics	37.1h	
Caregivers (Doctors, Nurses, etc)	37.1i	
Patients	37.1j	
Community	37.1k	

Are internal circulation routes clear, efficient and convenient?

Yes	38		1
No			2

If no, how can the general and specific design requirements in the DGAEF improve internal accessibility with minimum walking distances? *(Tick the appropriate answer/s)*

	38.1	
Consistency in use of Signs	38.1a	
Signs in 11 Languages	38.1b	
Presence of Information Desk at Entrances	38.1c	
Technological Assistance	38.1d	
Layout plan at the entrance of all Departments	38.1e	

Can DGAEF used for space design and provision of A&E facilities contribute positively to improving the following patient special needs? *(Tick the appropriate answer/s which correspond to your views)*

	39	
Reduction of human noise level	39a	
Reduction of equipment noise level	39b	
Access to room temperature and light control	39c	
Access to information technology	39d	
Access to social space for interaction	39e	
Easy surveillance of patient/family by caregivers	39f	
Accessible built environment (physically challenged	39g	
Grieving spaces	39h	

Do we need to provide for speciality facilities (e.g. chest pain unit, occupational health etc) in A&E facilities?

Yes	40		1
No			2

If yes, which unit/s would be provided for in the A&E facilities? *(Tick the appropriate answer/s)*

	40.1	
Chest Pain Unit	40.1a	
Occupational Health Unit	40.1b	
Poison Control Centre	40.1c	
Bums Unit	40.1d	

Are you in favour of introducing general and specific design requirements in the DGAEF for private rooms in short stay wards in A&E facilities?

Yes	41		1
No			2

If yes, state why? 41.1

…………………………………………………………………………………………..…

…………………………………………………………………………………………..…

Can the introduction of general and specific design requirements in the DGAEF for private rooms in short stay wards in the A&E facilities improve patient privacy and dignity?

Yes	42		1
No			2

If yes, state how/ why? 42.1

…………………………………………………………………………………………..…

…………………………………………………………………………………………..…

Is it necessary to introduce general and specific design requirements in the DGAEF for obstetrics and gynaecology space in A&E facilities?

Yes	43		1
No			2

If yes, state why? 43.1

…………………………………………………………………………………………..…

…………………………………………………………………………………………..…

Is it necessary to introduce in the general and specific design requirements in the DGAEF for paediatric space in A&E facilities?	Yes	44		
	No			

If yes, state why? 44.1

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……………………………………………………………………………………………

Is it necessary to introduce general and specific design requirements in the DGAEF for psychiatric patients' space in A&E facilities?	Yes	45		1
	No			2

If yes, state why? 45.1

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……………………………………………………………………………………………

Can the general and specific design requirements in the DGAEF limit innovation in space design and provision of A&E facilities?	Yes	46		1
	No			2

If yes, state why? 46.1

……………………………………………………………………………………………

……………………………………………………………………………………………

Which of these measures, if introduced, would promote compliance to the DGAEF amongst consultants? *(Tick the appropriate answer)*	Good Design Brief	47		1
	Ease of Use Design Norms			2
	Adaptability			3
	Obligation			4
	Reward			5

Can appointment of consultants for A&E projects through competitive procedures influence compliance to DGAEF?	Yes	48		1
	No			2

If yes, state why? 48.1

……………………………………………………………………………………………

……………………………………………………………………………………………

Section D: General Opinions and Views on DGAEF

In this section, we would like to know your views on key issues in the DGAEF (1987) that are constraining the delivery of A&E facilities in South Africa.
(Rank the obstacles 1 = Very Low, 2 = Low, 3 = Moderate, 4 = High,5 = Very High)

Please rank in your opinion, the major obstacles constraining the project development of A&E facilities in South Africa?

	49	
Inappropriateness of the general and specific requirements in the DGAEF	49a	
Poor project briefing systems	49b	
Lack of Standardization	49c	
No feedback loop	49d	
Lack of research in this field	49e	
Lack of post occupancy evaluation system	49f	
Poor medium of communication tools for professional disciplines involved	49g	
Poor budget provision	49h	
Inconsistency in master plan of healthcare institution	49i	
Lack of design quality indicators for space design and provision, functional suitability and spatial relationships	49j	
No demonstration projects	49k	
Lack of qualified healthcare architects	49l	
Provincial Department of Health	49m	
Provincial Department of Public Works	49n	
National Department of Health	49o	
Poor project technical documentations during project development phase	49p	
Subjective attitude and behaviour of the actors involved	49q	

The statements below refer to issues regarding compliance to DGAEF. After reading, indicate how much you agree with each statement

Rank the statements a follows: 1 = Strongly Disagree, 2 = Disagree, 3 = Undecided, 4 = Agree, 5 = Strongly Agree

	50	
Update of the DGAEF is long overdue	50a	
Provincial Department of Health lack appropriate general and specific design requirements in the DGAEF for project briefing	50b	
Inefficient and ineffective information systems during pre and post implementation phases of healthcare projects	50c	
Assigning the implementation of A&E facilities project to National Department of Public Works would improve their delivery	50d	
Introducing design quality indicators obtained through research would improve space design and provision for A&E facilities	50e	
Post occupancy evaluation document and continuous feedback culture is necessary	50f	
Healthcare projects are not completed within project programme and budgets	50g	
Development of standard project development tools should improve life-cycle costing	50h	
Sustainable design should be encouraged and rewarded	50i	
Project finance for healthcare facilities should be prioritised to in order to meet MDG targets	50j	

Finally, what are your views or suggestions on the update of the general and specific design requirements in the DGAEF? 51

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Appendix D: Questionnaire for Caregivers

Appendix D: Questionnaire for Caregivers

Questionnaire for Caregiver (Non-Physician, Clinical Staff and Physician)

No.	SN/B	50		Survey of the role of design guidelines (DGs) for Accident and Emergency Facilities (A&E) in South Africa

We would like to ask you to complete this questionnaire about your experience on the use of DGs for the development of A&E healthcare facilities in South Africa. Your answers are important and will assist the researcher in the update of the DGs for the design of A&E Facilities (DGAEF).

Department: …………………………	Date:…………………………….……

Section A: Personal Background Of Respondents

In this section, we would like to ask you a set of questions about your gender, age, experience, place of residence, qualifications, and marital status.

Gender?

Male	1.		1
Female			2

What is your age?

Years	2.		1

What is your home language?

English	3.		1
Afrikaans			2
Isixhosa			3
Isizulu			4
Sesotho			5
Setswana			6
Sepedi			7
Seswati			8
Tshivenda			9
Zistonga			10
Isindbele			11
Other			12

Where do you reside?

City	4.		1
Town			2
Rural/Farm			3

What is your education level?

Under Primary Certificate	5.		1
Under Secondary Certificate			2
Secondary Certificate			3
Diploma			4
University Degree			5
Other			6

What is your Professional Qualification?	……………………………………………	6
Are you a member of any professional body/bodies?	……………………………………………	7
What is your current position in this organisation?	……………………………………………	8
How long have you been in this position?	……………………………………………	9

Section B: Design Guidelines for A&E Facilities (DGAEF)

In this section you would be asked questions regarding the effects of general and specific design requirements in the DGAEF on efficiency and effectiveness of healthcare services delivery in the A&E facilities.

Have you or a family member been to an A&E facility for medical treatment in the past 12 months? *(Tick the appropriate answer)*

Yes	10.		1
No			2

If yes, which type of A&E facility did you or a family member go to? *(Tick the appropriate answer/s)*

	11	
Primary Healthcare Clinic	11a	
District Hospital	11b	
Provincial/ Regional Hospital	11c	
Other	11d	

Which means of transport did you use to get to the A&E facility? *(Tick the appropriate answer)*

Walked	12.	☐	1
Own Car		☐	2
Other Private Car		☐	3
Bus		☐	4
Train		☐	5
Taxi		☐	6
Ambulance/Emergency Vehicles		☐	7

How far did you have to travel to get to the A&E facility? *(Tick the appropriate answer)*

Less than 5 km	13	☐	1
5km – 10 km		☐	2
10 km – 50 km		☐	3
More than 50 km		☐	4

What is your estimated travelling time to the nearest A&E facility? *(Tick the appropriate answer)*

Less than 30mins	14	☐	1
30 mins to 1 hr		☐	2
1 to 2 hrs		☐	3

If yes what was the average response time from logging the call? *(Tick the appropriate answer)*

0 – 15 mins	15	☐	1
15 mins – 30 mins		☐	2
30 mins to 1 hr		☐	3
1 to 2 hrs		☐	4

Are car park, taxi, bus stops and entrances easy to find and located close to the A&E building?

Yes	16	☐	1
No		☐	2

Are entrance approaches to surrounding areas welcoming and easy to find?

Yes	17	☐	1
No		☐	2

Are you familiar with the DGAEF?

Yes	18	☐	1
No		☐	2

Do you have any further comments or opinions on this issue? 18.1

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Is the A&E facilities designed with the DGAEF adequate to providing quality healthcare services delivery?*(Tick the appropriate answer)*

Completely adequate	19.	☐	1
Adequate		☐	2
Undecided		☐	3
Inadequate		☐	4
Completely inadequate		☐	5

Do you have any further comments or opinions on this issue? 19.1

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In your view would the introduction of a fast track area in A&E facilities improve efficiency in service delivery?

Yes	20	☐	1
No		☐	2

If your answer is yes in which area/s would you prefer it? *(Tick the appropriate answer/s)* 20.1

In admission Area	20.1a	☐	1
In Triage Area	20.1b	☐	2
At the Entrance	20.1c	☐	3
Examination Area	20.1d	☐	4
Next to Information Desk	20.1e	☐	5

Does the DGAEF used for space design allow for the provision of adequate facilities that would improve patient comfort in A&E facilities? *(Tick the appropriate answer)*

Completely adequate	21	☐	1
Adequate		☐	2
Undecided		☐	3
Inadequate		☐	4
Completely inadequate		☐	5

Do you have any further comments or opinions on this issue? 21.1

…………………………………………………………………………………………

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Are you in favour of introducing standard project development tools for A&E facilities with provision for minor changes?

	22		
Yes		☐	1
No		☐	2

Do you have any further comments or opinions on this issue? 22.1

…………………………………………………………………………………………

…………………………………………………………………………………………

In which of these areas do you think that introduction of "adaptable" and "flexible" standard project development tools would improve efficient and effective use of resources? *(Tick the appropriate answer/s)*

	23	
Examination Area	23a	☐
Stretchers Exam Area	23b	☐
Treatment Area	23c	☐
Resuscitation Area	23d	☐
Counselling Area	23e	☐
Triage Area	23f	☐

Do you have any further comments or opinions on this issue? 23.1

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In your opinion would the use of technology (e.g. computer programmes, build information modelling and mock-ups) assist in the efficient and effective design of A&E facilities?

	24		
Yes		☐	1
No		☐	2

Do you have any further comments or opinions on this issue? 24.1

…………………………………………………………………………………………

…………………………………………………………………………………………

Please indicate in which of these A&E spaces you think the DGAEF need to be improved for more efficient use of A&E spaces? ***(Tick the appropriate answer/s)***

	25	
Entrance	25a	☐
Reception	25b	☐
Waiting	25c	☐
Security	25d	☐
Triage	25e	☐
Ablutions	25f	☐
Information	25g	☐
Admission	25h	☐
Consulting/Exam	25i	☐
Counselling	25j	☐
Treatment/POP	25k	☐
Short Stay Ward	25l	☐
Duty/Staff Room	25m	☐
Nurses Station	25n	☐
Office Waiting	25o	☐
Administration	25p	☐

Indicate design quality indicators you believe need to be included in the DGAEF to improve efficiency and effectiveness of the operational spaces and healthcare services delivery through the space design and provision of A&E facilities? 26

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Section C: The New Approach to DGAEF Update Based on Planetree Principles

In this section you would be asked questions regarding the influence of the DGs on the A&E facilities, healthcare services delivery culture, the society, and persons or users and also on the space design and provision functional suitability, space utilisation and spatial relationships.

In which of these areas do you think that the DGAEF used for space design and provision for A&E layout plan need to be improved to enhance interaction amongst staff, patient and family members? *(Tick the appropriate answer/s)*

	27	
Introduction of separate staff/patient corridors	27a	☐
Larger Examination Rooms	27b	☐
Introduction of Resource Centre/Library	27c	☐
Children Entertainment Area	27d	☐
Patient/Family Private waiting Area	27e	☐

Do you have any further comments or opinions on this issue? 27.1

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Do you think that participatory approach in update of DGAEF will result in the design of a good healing physical environment?

Yes	28		1
No			2

If yes, who should participate? *(Tick the appropriate answer)*

	28.1	
National/Provincial Department of Health	28.1a	
National/Provincial Department of Public Works	28.1b	
Department of Social Services	28.1c	
Department of Education	28.1d	
Department of Finance	28.1e	
Professional Teams (Architects, Engineers, etc) Consultants	28.1f	
Construction Companies	28.1g	
Academics	28.1h	
Caregivers (Doctors, Nurses, etc)	28.1i	
Patients	28.1j	
Community	28.1k	

Are internal circulation routes clear, efficient and convenient?

Yes	29		1
No			2

If no, how can the general and specific design requirements in the DGAEF improve internal accessibility with minimum walking distances? *(Tick the appropriate answer/s)*

	29.1	
Consistency in use of Signs	29.1a	
Signs in 11 Languages	29.1b	
Presence of Information Desk at Entrances	29.1c	
Technological Assistance	29.1d	
Layout plan at the entrance of all Departments	29.1e	

Can DGAEF used for space design and provision of A&E facilities contribute positively to improving the following patient special needs? *(Tick the appropriate answer/s which correspond to your views)*

	30	
Reduction of human noise level	30a	
Reduction of equipment noise level	30b	
Access to room temperature and light control	30c	
Access to information technology	30d	
Access to social space for interaction	30e	
Easy surveillance of patient/family by caregivers	30f	
Accessible built environment (physically challenged	30g	
Grieving spaces	30h	

Do we need to provide for speciality facilities (e.g. chest pain unit, occupational health etc) in A&E facilities?

Yes	31		1
No			2

If yes, which unit/s would be provided for in the A&E facilities? *(Tick the appropriate answer/s)*

	31.1	
Chest Pain Unit	31.1a	
Occupational Health Unit	31.1b	
Poison Control Centre	31.1c	
Burns Unit	31.1d	

Are you in favour of introducing general and specific design requirements in the DGAEF for private rooms in short stay wards in A&E facilities?

Yes	32		1
No			2

If yes, state why? 32.1

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Can the introduction of general and specific design requirements in the DGAEF for private rooms in short stay wards in the A&E facilities improve patient privacy and dignity?

Yes	33		1
No			2

If yes, state how/ why? 33.1

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……………………………………………………………………………………………

Is it necessary to introduce general and specific design requirements in the DGAEF for obstetrics and gynaecology space in A&E facilities?	Yes	34		1
	No			2

If yes, state why? 34.1

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Is it necessary to introduce in the general and specific design requirements in the DGAEF for paediatric space in A&E facilities?	Yes	35	
	No		

If yes, state why? 35.1

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Is it necessary to introduce general and specific design requirements in the DGAEF for psychiatric patients' space in A&E facilities?	Yes	36		1
	No			2

If yes, state why? 36.1

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Section D: General Opinions and Views on DGAEF

In this section, we would like to know your views on key issues in the DGAEF (1987) that are constraining the delivery of A&E facilities in South Africa.
(Rank the obstacles 1 = Very Low, 2 = Low, 3 = Moderate, 4 = High,5 = Very High)

Please rank in your opinion, the major obstacles constraining the project development of A&E facilities in South Africa?

	37	
Inappropriateness of the general and specific requirements in the DGAEF	37a	
Poor project briefing systems	37b	
Lack of Standardization	37c	
No feedback loop	37d	
Lack of research in this field	37e	
Lack of post occupancy evaluation system	37f	
Poor medium of communication tools for professional disciplines involved	37g	
Poor budget provision	37h	
Inconsistency in master plan of healthcare institution	37i	
Lack of design quality indicators for space design and provision, functional suitability and spatial relationships	37j	
No demonstration projects	37k	
Lack of qualified healthcare architects	37l	
Provincial Department of Health	37m	
Provincial Department of Public Works	37n	
National Department of Health	37o	
Poor project technical documentations during project development phase	37p	
Subjective attitude and behaviour of the actors involved	37q	

The statements below refer to issues regarding compliance to DGAEF for A&E facilities. After reading, indicate how much you agree with each statement

Rank the statements a follows: 1 = Strongly Disagree, 2 = Disagree, 3 = Undecided, 4 = Agree, 5 = Strongly Agree

	38	
Update of DGAEF is long overdue	38a	
Provincial Department of Health lack appropriate general and specific design requirements in the DGAEF for project briefing	38b	
Inefficient resources during pre and post implementation phases of healthcare projects	38c	
Assigning the implementation of A&E facilities project to National Department of Public Works would improve their delivery	38d	
Introducing design quality indicators obtained through research would improve space design and provision for A&E facilities	38e	
Post occupancy evaluation document and continuous feedback culture is necessary	38f	
Healthcare projects are not completed within project programme and budgets	38g	
Development of standard project development tools should improve life-cycle costing	38h	
Sustainable design should be encouraged and rewarded	38i	
Project finance for healthcare facilities should be prioritised to in order to meet MDG targets	38j	

Finally, what are your views or suggestions on the update of the general and specific design requirements in the DGAEF? 39

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Appendix E: Questionnaire for Patients/Community

Questionnaire for Patients/Community

No.	SN/B	50		Survey of the role of design guidelines (DGs) for Accident and Emergency Facilities (A&E) in South Africa

We would like to ask you to complete this questionnaire about your experience on the use of DGs for the development of A&E healthcare facilities in South Africa. Your answers are important and will assist the researcher in the update of the DGs for the design of A&E Facilities (DGAEF).

Department: …………………………	Date:……………………………..……

Section A: Personal Background Of Respondents

In this section, we would like to ask you a set of questions about your gender, age, experience, place of residence, qualifications, and marital status.

Gender?

Male	1.	☐	1
Female		☐	2

What is your age?

Years	2.	☐	1

What is your home language?

English	3.	☐	1
Afrikaans		☐	2
Isixhosa		☐	3
Isizulu		☐	4
Sesotho		☐	5
Setswana		☐	6
Sepedi		☐	7
Seswati		☐	8
Tshivenda		☐	9
Zistonga		☐	10
Isindbele		☐	11
Other		☐	12

Where do you reside?

City	4.	☐	1
Town		☐	2
Rural/Farm		☐	3

What is your education level?

Under Primary Certificate	5.	☐	1
Under Secondary Certificate		☐	2
Secondary Certificate		☐	3
Diploma		☐	4
University Degree		☐	5
Other		☐	6

Section B: Design Guidelines for A&E Facilities (DGAEF)

In this section you would be asked questions regarding the effects of design guidelines in the existing norms on efficiency and effectiveness of health care services delivery in the A&E facilities.

Have you or a family member been to an A&E facility for medical treatment in the past 12 months? *(Tick the appropriate answer)*

Yes	6.	☐	1
No		☐	2

If yes, which type of A&E healthcare facility did you or a family member go to? *(Tick the appropriate answer/s)*

	7	
Primary Healthcare Clinic	7a	☐
District Hospital	7b	☐
Provincial/ Regional Hospital	7c	☐
Other	7d	☐

Which means of transport did you use to get to the A&E facility? *(Tick the appropriate answer)*

Walked	8	☐	1
Own Car		☐	2
Other Private Car		☐	3
Bus		☐	4
Train		☐	5
Taxi		☐	6
Ambulance/Emergency Vehicle		☐	7

If you used an Ambulance, how long did it take forit to reach you after you made the call? *(Tick the appropriate answer)*

0 – 15 mins	8.1	☐	1
15 mins – 30 mins		☐	2
30 mins to 1 hr		☐	3
1 to 2 hrs		☐	4

How far did you have to travel to get to the A&E facility? *(Tick the appropriate answer)*

Less than 5Km	9	☐	1
5Km- 10Km		☐	2
10Km- 50Km		☐	3
More than 50Km		☐	4

How long did it take you to reach the A&E facility? *(Tick the appropriate answer)*

Less than 30mins	10	☐	1
30 mins to 1 hr		☐	2
1 to 2 hrs		☐	3

Was this the nearest A&E facility?

Yes	11	☐	1
No		☐	2

If no, why did you have/choose to use it? 11.1

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Are car park, taxi, bus stops and entrances easy to find and located close to the A&E building?

Yes	12	☐	1
No		☐	2

Are entrance approaches to surrounding areas welcoming and easy to find?

Yes	13	☐	1
No		☐	2

Do you have any further comments or opinions on any of the above? 13.1

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Are you familiar with the DGAEF?

Yes	14	☐	1
No		☐	2

Is the A&E facilities designed with the DGAEF adequate to providing quality healthcare services delivery?*(Tick the appropriate answer)*

Completely adequate	15	☐	1
Adequate		☐	2
Undecided		☐	3
Inadequate		☐	4
Completely inadequate		☐	5

Do you have any further comments or opinions on this issue? 15.1

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……………………………………………………………………………………………

In your view would a fast track area in A&E facilities improve service delivery?

Yes	16	☐	1
No		☐	2

If your answer is yes, in which area/s would you prefer it? *(Tick the appropriate answer)*

In admissions Area	16.1	☐	1
In Triage Area	16.2	☐	2
At the Entrance	16.3	☐	3
Examination Area	16.4	☐	4
Next to Information Desk	16.5	☐	5

Does the DGAEF used for space design allow for the provision of adequate facilities that would improve patient comfort in A&E facilities? *(Tick the appropriate answer)*

Completely adequate	17	☐	1
Adequate		☐	2
Undecided		☐	3
Inadequate		☐	4
Completely inadequate		☐	5

Do you have any further comments or opinions on this issue? 17.1

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Please indicate in which of these A&E spaces you think the DGAEF need to be improved for more efficient use of A&E spaces? ***(Tick the appropriate answer/s)*** 18

Entrance	18a	☐
Reception	18b	☐
Waiting	18c	☐
Security	18d	☐
Triage	18e	☐
Ablutions	18f	☐
Information	18g	☐
Admission	18h	☐
Consulting/Exam	18i	☐
Counselling	18j	☐
Treatment/POP	18k	☐
Short Stay Ward	18l	☐
Duty/Staff Room	18m	☐
Nurses Station	18n	☐
Office Waiting	18o	☐
Administration	18p	☐

Question	Option	Code	Value
Which means of transport did you use to get to the A&E facility? *(Tick the appropriate answer)*	Walked	12.	1
	Own Car		2
	Other Private Car		3
	Bus		4
	Train		5
	Taxi		6
	Ambulance/Emergency Vehicles		7

Question	Option	Code	Value
How far did you have to travel to get to the A&E facility? *(Tick the appropriate answer)*	Less than 5 km	13	1
	5km – 10 km		2
	10 km – 50 km		3
	More than 50 km		4

Question	Option	Code	Value
What is your estimated travelling time to the nearest A&E facility? *(Tick the appropriate answer)*	Less than 30mins	14	1
	30 mins to 1 hr		2
	1 to 2 hrs		3

Question	Option	Code	Value
If yes what was the average response time from logging the call? *(Tick the appropriate answer)*	0 – 15 mins	15	1
	15 mins – 30 mins		2
	30 mins to 1 hr		3
	1 to 2 hrs		4

Question	Option	Code	Value
Are car park, taxi, bus stops and entrances easy to find and located close to the A&E building?	Yes	16	1
	No		2

Question	Option	Code	Value
Are entrance approaches to surrounding areas welcoming and easy to find?	Yes	17	1
	No		2

Question	Option	Code	Value
Are you familiar with the DGAEF?	Yes	18	1
	No		2

Do you have any further comments or opinions on this issue? 18.1

……………………………………………………………………………………………………

……………………………………………………………………………………………………

Question	Option	Code	Value
Is the A&E facilities designed with the DGAEF adequate to providing quality healthcare services delivery? *(Tick the appropriate answer)*	Completely adequate	19.	1
	Adequate		2
	Undecided		3
	Inadequate		4
	Completely inadequate		5

Do you have any further comments or opinions on this issue? 19.1

……………………………………………………………………………………………

……………………………………………………………………………………………

Question	Option	Code	Value
In your view would the introduction of a fast track area in A&E facilities improve efficiency in service delivery?	Yes	20	1
	No		2

Question	Option	Code	Value
If your answer is yes in which area/s would you prefer it? *(Tick the appropriate answer/s)*		20.1	
	In admission Area	20.1a	1
	In Triage Area	20.1b	2
	At the Entrance	20.1c	3
	Examination Area	20.1d	4
	Next to Information Desk	20.1e	5

Question	Option	Code	Value
Does the DGAEF used for space design allow for the provision of adequate facilities that would improve patient comfort in A&E facilities? *(Tick the appropriate answer)*	Completely adequate	21	1
	Adequate		2
	Undecided		3
	Inadequate		4
	Completely inadequate		5

Do you have any further comments or opinions on this issue? 21.1

……………………………………………………………………………………………

……………………………………………………………………………………………

Are you in favour of introducing standard project development tools for A&E facilities with provision for minor changes?

Yes	22		1
No			2

Do you have any further comments or opinions on this issue? 22.1

…………………………………………………………………………………………

…………………………………………………………………………………………

In which of these areas do you think that introduction of "adaptable" and "flexible" standard project development tools would improve efficient and effective use of resources? *(Tick the appropriate answer/s)*

	23	
Examination Area	23a	
Stretchers Exam Area	23b	
Treatment Area	23c	
Resuscitation Area	23d	
Counselling Area	23e	
Triage Area	23f	

Do you have any further comments or opinions on this issue? 23.1

…………………………………………………………………………………………

…………………………………………………………………………………………

In your opinion would the use of technology (e.g. computer programmes, build information modelling and mock-ups) assist in the efficient and effective design of A&E facilities?

Yes	24		1
No			2

Do you have any further comments or opinions on this issue? 24.1

…………………………………………………………………………………………

…………………………………………………………………………………………

Please indicate in which of these A&E spaces you think the DGAEF need to be improved for more efficient use of A&E spaces? *(Tick the appropriate answer/s)*

	25	
Entrance	25a	
Reception	25b	
Waiting	25c	
Security	25d	
Triage	25e	
Ablutions	25f	
Information	25g	
Admission	25h	
Consulting/Exam	25i	
Counselling	25j	
Treatment/POP	25k	
Short Stay Ward	25l	
Duty/Staff Room	25m	
Nurses Station	25n	
Office Waiting	25o	
Administration	25p	

Indicate design quality indicators you believe need to be included in the DGAEF to improve efficiency and effectiveness of the operational spaces and healthcare services delivery through the space design and provision of A&E facilities? 26

…………………………………………………………………………………………

…………………………………………………………………………………………

Section C: The New Approach to DGAEF Update Based on Planetree Principles

In this section you would be asked questions regarding the influence of the DGs on the A&E facilities, healthcare services delivery culture, the society, and persons or users and also on the space design and provision functional suitability, space utilisation and spatial relationships.

In which of these areas do you think that the DGAEF used for space design and provision for A&E layout plan need to be improved to enhance interaction amongst staff, patient and family members? *(Tick the appropriate answer/s)*

	27	
Introduction of separate staff/patient corridors	27a	
Larger Examination Rooms	27b	
Introduction of Resource Centre/Library	27c	
Children Entertainment Area	27d	
Patient/Family Private waiting Area	27e	

Appendix F: Questions for Semi-Structured Interview for Consultants

Questions for Semi-Structured Interview for Consultants

Questions for Semi-Structured Interview for Architects, Quantity Surveyor, Civil, Structural, Electrical and Mechanical Engineers

No.	SN/B	50		Interview on the role of design guidelines (DGs) for Accident and Emergency Facilities (A&E) in South Africa

We would like you to participate in this interview by answering questions regarding your experience in use of A&E healthcare facilities in South Africa. Your answers are important and will assist the researcher in the update of the DGs for the design of A&E facilities (DGAEF).

Department: …………………………	Date:…………………………..……

Result Codes	01	Complete		02	Partly Complete	

Duration of Interview	Start		Finish		Total	

In which province was the interview conducted? ……………………………………………..

Section A: Design Guidelines for A&E facilities (DGAEF)

In this section you would be asked questions regarding the effects of general and specific design requirements in the DGAEF on efficiency and effectiveness of healthcare services delivery in the A&E facilities.

1. Are you familiar with the DGAEF?
2. Have you used this DGAEF before for space design and provision of A&E facilities?
3. What is the extent of the current compliance with the DGAEF amongst consultants?
4. Can A&E facilities designed with the DGAEF facilitate quality healthcare services delivery?
5. In your view would the introduction of a fast track area in the update of DGAEF improve efficiency in healthcare services delivery?
6. In your opinion is the maximum area requirements for space design and provision in the DGAEF adequate?
7. What is the average current cost per square metre using the DGAEF?
8. Do you think that the budget allocation for A&E facilities are currently effectively spent?
9. How long does it take to construct the following healthcare facilities from project briefing to completion (*level 1, level 2, level 3*)?
10. Do you think that this is an efficient and effective timeframe?
11. Do you think it is appropriate in relation to meeting the national need for A&E facilities?
12. Does the general and specific design requirements in the DGAEF allow for adequate patient comfort in A&E facilities?
13. Are you in favour of introducing standard project development tools for A&E facilities with provision for minor changes?
14. In which of these area do you think that introduction of “adaptable” and “flexible use” standard project development tools could enable a more effective and efficient use of resources (*examination area, stretchers exam area, treatment area, resuscitation area, counselling area, triage area*)?
15. In your pinion would the use of technology (e.g. computer programmes, build information modelling and mock-ups) assist in the efficient and effective design of A&E facilities?
16. In which areas do you think that the DGs need to be improved for more efficient use of A&E spaces?

Section B: The New approach to DGAEF Update Based on Planetree Principles

In this section you would be asked questions regarding the influence of the DGs on the A&E facilities, healthcare services delivery culture, the society, and persons or users and also on the space design and provision functional suitability, space utilisation and spatial relationships.

17. Can A&E layout plan be improved to enhance interaction amongst staff, patient and family member?
18. Do you think that a participatory approach in review of DGAEF will result in the design of an improved A&E facilities?
19. Are internal circulation routes clear, efficient and convenient?
20. If no, how can design guidelines in the DGAEF improve internal accessibility with minimum walking distances?
21. Can design guidelines for A&E contribute positively to improving patient special needs (*noise, equipment noise, access to room temperature and light control, access to information technology, access to social space for interaction*)?
22. Do we need to provide for speciality facilities (e.g. chest pain unit, occupational health etc) in A&E facilities?
23. Are you in favour of introducing in the DGAEF general and specific design requirements for private rooms in short stay wards in A&E facilities?

24. Can the introduction in the DGAEF general and specific design requirements for private rooms in short stay wards in the A&E facilities to improve patient privacy and dignity?

25. Is it necessary to introduce general and specific design requirements in the DGAEF for: obstetrics and gynaecology space in A&E facilities?

26. Is it necessary to introduce general and specific design requirements in the DGAEF for: paediatric space in A&E facilities?

27 Is it necessary to introduce general and specific design requirements in the DGAEF for: psychiatric patients' space in A&E facilities?

28 Does general and specific design requirements in DGAEF limit innovation in design of A&E facilities?

29 Which of these measures, if introduced, would promote compliance to DGAEF amongst consultants: good design brief; ease to use DGs and sets of design quality indicators?

30 Can appointment of multidisciplinary project team for healthcare facilities projects through competitive procedures influence compliance to DGAEF?

Appendix G: Questions for Semi-Structured Interview for Caregivers

Questions for Semi-Structured Interview for Caregivers

Questions for Semi-Structured Interview for Caregiver (Non-Physician, Clinical Staff and Physician)

No.	SN/B	50		Interview on the role of design guidelines (DGs) for Accident and Emergency Facilities (A&E) in South Africa

We would like you to participate in this interview by answering questions regarding your experience in use of A&E healthcare facilities in South Africa. Your answers are important and will assist the researcher in the update of the DGs for the design of A&E facilities (DGAEF).

Department: …………………………	Date:……………………………..……

Result Codes	01	Complete		02	Partly Complete	

Duration of Interview	Start		Finish		Total	
In which province was the interview conducted? ……………………………………………..						

Section A: Design Guidelines for A & E Facilities (DGAEF)

In this section you would be asked questions regarding the effects of general and specific design requirements in the DGAEF on efficiency and effectiveness of healthcare services delivery in the A&E facilities.

1. Are you familiar with the c DGAEF?
2. Can A&E facilities designed with the DGs facilitate quality healthcare services delivery?
3. In your view would the introduction of a fast track area in the update of DGAEF improve efficiency in healthcare services delivery?
4. In your opinion, are maximum areas requirements in the DGAEF adequate?
5. Does the general and specific design requirements in the DGs allow for adequate patient comfort in A&E facilities?
6. Are you in favour of introducing standard project development tools for A&E facilities with provision for minor changes?
7. In which of these area do you think that introduction of "adaptable" and "flexible use" standard project development tools could enable a more effective and efficient use of resources (*examination area, stretchers exam area, treatment area, resuscitation area, counselling area, triage area*)?
8. In your pinion would the use of technology (e.g. computer programmes, build information modelling and mock-ups) assist in the efficient and effective design of A&E facilities?
9. In which areas do you think that the DGs need to be improved for more efficient use of A&E spaces?

Section B: The New approach to DGAEF Update Based on Planetree Principles

In this section you would be asked questions regarding the influence of the DGs on the A&E facilities, healthcare services delivery culture, the society, and persons or users and also on the space design and provision functional suitability, space utilisation and spatial relationships.

10. Can A&E layout plan be improved to enhance interaction amongst staff, patient and family member?

11. Do you think that a participatory approach in update of DGs will result in the design of an improved A&E facilities?

12. Are internal circulation routes clear, efficient and convenient?

13. If no, how can design guidelines in the DGAEF improve internal accessibility with minimum walking distances?

14. Can design guidelines for A&E contribute positively to improving patient special needs (*noise, equipment noise, access to room temperature and light control, access to information technology, access to social space for interaction*)?

15. Do we need to provide for speciality facilities (e.g. chest pain unit, occupational health etc) in A&E facilities?

16. Are you in favour of introducing in the DGs general and specific design requirements for private rooms in short stay wards in A&E facilities?

17. Can the introduction in the DGs general and specific design requirements for private rooms in short stay wards in the A&E facilities to improve patient privacy and dignity?

18. Is it necessary to introduce general and specific design requirements in the DGs for: obstetrics and gynaecology space in A&E facilities?

19. Is it necessary to introduce general and specific design requirements in the DGs for: paediatric space in A&E facilities?

20 Is it necessary to introduce general and specific design requirements in the DGs for: psychiatric patients' space in A&E facilities?

Appendix H: Questions for Semi-Structured Interview for Patients and Community

Questions for Semi-Structured Interview for Patients and Community

Questions for Semi-Structured Interview for Patients and Community

No.	SN/B	50		Interview on the role of design guidelines (DGs) for Accident and Emergency Facilities (A&E) in South Africa

We would like you to participate in this interview by answering questions regarding your experience in use of A&E healthcare facilities in South Africa. Your answers are important and will assist the researcher in the update of the DGs for the design of A&E facilities (DGAEF).

Department: ………………………….	Date:……………………………..……

Result Codes	01	Complete		02	Partly Complete	

Duration of Interview	Start		Finish		Total	

In which province was the interview conducted? ……………………………………………..

Section A: Design Guidelines for A&E facilities (DGAEF)

In this section you would be asked questions regarding the effects of general and specific design requirements in the current DGAEF on efficiency and effectiveness of healthcare services delivery in the A&E facilities.

1. Are you familiar with the DGs for (A&E) facilities?
2. Can A&E facilities designed with the DGs facilitate quality healthcare services delivery?
3. In your view would the introduction of a fast track area in the review of current DGs for A&E facilities improve efficiency in healthcare services delivery?
4. In your opinion, are current space requirements in the DGs for A&E facilities adequate?
5. In your pinion would the use of technology (e.g. computer programmes, build information modelling and mock-ups) assist in the efficient and effective design of A&E facilities?
6. Are you in favour of introducing standard project development tools for A&E facilities with provision for minor changes?
7. Does the DGAEF used for space design allow for the provision of adequate facilities that would improve patient comfort in A&E facilities?
8. In which areas do you think that the current DGs need to be improved for more efficient use of A&E spaces?

Section B: The New Approach to DGAEF Update Based Principles

In this section you would be asked questions regarding the influence of the DGs on the A&E facilities, healthcare services delivery culture, the society, and persons or users and also on the space design and provision functional suitability, space utilisation and spatial relationships.

9. Can A&E layout plan be improved to enhance interaction amongst staff, patient and family member?
10. Do you think that a participatory approach in review of DGs will result in the design of an improved A&E facilities?
11. Are internal circulation routes clear, efficient and convenient?
12. If no, how can design guidelines in the DGAEF improve internal accessibility with minimum walking distances?
13. Can design guidelines for A&E contribute positively to improving patient special needs (*noise, equipment noise, access to room temperature and light control, access to information technology, access to social space for interaction*)?
14. Do we need to provide for speciality facilities (e.g. chest pain unit, occupational health etc) in A&E facilities?
15. Are you in favour of introducing in the DGs general and specific design requirements for private rooms in short stay wards in A&E facilities?
16. Can the introduction in the DGs general and specific design requirements for private rooms in short stay wards in the A&E facilities to improve patient privacy and dignity?
17. Is it necessary to introduce general and specific design requirements in the DGs for: obstetrics and gynaecology space in A&E facilities?
18. Is it necessary to introduce general and specific design requirements in the DGs for: paediatric space in A&E facilities?
19. Is it necessary to introduce general and specific design requirements in the DGs for: psychiatric patients' space in A&E facilities?

Appendix I: Floor Plan Analysis Data Collection Protocol Sheet

Floor Plan Analysis Data Collection Protocol Sheet

CHBH A&E FACILITY SOWETO, JOHANNESBURG

No.	SN/B	50		Floor plan analysis: the role of design guidelines for Accident and Emergency Facilities (A&E) in South Africa

.

Department: …………………………	Date:……………………………..……

Result Codes	01	Complete		02	Partly Complete	

Duration of Fieldwork	Start		Finish		Total	

In which zone of the department: A, B, C and D? ……………………………………………..

Section A: Design Guidelines for A & E Facilities

In this section information on the influence of the existing design guidelines on the efficiency and effectiveness of space design and provision, functional suitability and spatial relationships in relation to the quality of the healthcare services delivery are investigated.

1. Zone A?

   1.1 Entrance?

   1.2 Waiting?

   1.3 Reception?

   1.4 Admission?

   1.5 Triage?

2. Zone B?

   2.1 Examination (minor and major rooms)?

   2.2 Treatment rooms (resuscitation rooms and other rooms)?

3. Zone C?

   3.1 Clinical observation area (short stay inpatient room)?

4. Zone D?

   4.1 Support or ancillary areas (administration, education, training, staff facilities and ablutions)?

Section B: Design Guidelines for A&E Facilities and an Alternative Approach for its Update

In this section information on the solutions on gaps, challenges and obstacles to the existing design guidelines is obtained in relation to the improvement design of the A&E facilities and quality of the healthcare services delivery are investigated.

1. DGAEF and an alternative approach to its update?
2. The influence of DGAEF on the quality of the physical environment in zones A, B, C and D?
3. The importance of user's participation in the project development process?
4. The role of DGAEF on technology innovation and update?
5. The influence of DGAEF on institutional transformation and operations?
6. The role of DGAEF on standardisation, pre-assembly?
7. The gaps, challenges and obstacles constraining compliance to the DGAEF?

Section C: Design Guidelines for A&E Facilities and an Alternative Approach for its Update

In this section information on the solutions on gaps, challenges and obstacles to the existing design guidelines is obtained in relation to the improvement design of the A&E facilities and quality of the healthcare services delivery are investigated

1. The gaps, challenges and obstacles constraining compliance to the DGAEF?

Appendix J: Observational Studies Data Collection Protocol Sheet

Participant Observation Data Collection Protocol Sheet

CHBH A&E FACILITY SOWETO, JOHANNESBURG

No.	SN/B	50		Participant observation: the role of design guidelines for Accident and Emergency Facilities (A&E) in South Africa

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Department: …………………………	Date:…………………………….……

Result Codes	01	Complete		02	Partly Complete		

Duration of Fieldwork	Start		Finish		Total		

In which zone of the department: A, B, C and D? ……………………….…………………..

Section A: Design Guidelines for A & E Facilities

In this section information on the influence of the existing design guidelines on the efficiency and effectiveness of space design and provision, functional suitability and spatial relationships in relation to the quality of the healthcare services delivery are investigated.

1. Zone A?

   1.1 Entrance?

   1.2 Waiting?

   1.3 Reception?

   1.4 Admission?

   1.5 Triage?

2. Zone B?

   2.1 Examination (minor and major rooms)?

   2.2 Treatment rooms (resuscitation rooms and other rooms)?

3. Zone C?

   3.1 Clinical observation area (short stay inpatient room)?

4. Zone D?

   4.1 Support or ancillary areas (administration, education, training, staff facilities and ablutions)?

Section B: Design Guidelines for A&E Facilities and an Alternative Approach for its Update

In this section information on the solutions on gaps, challenges and obstacles to the existing design guidelines is obtained in relation to the improvement design of the A&E facilities and quality of the healthcare services delivery are investigated.

1. The structure of the DGAEF and an alternative approach to its update?
2. The influence of DGAEF on the quality of the physical environment in zones A, B, C and D?
3. The importance of user's participation in the project development process?
4. The role of DGAEF on technology innovation and update?
5. The influence of DGAEF on institutional transformation and operations?
6. The role of DGAEF on standardisation, pre-assembly?
7. The gaps, challenges and obstacles constraining compliance to the DGAEF?

Section C: The gaps, challenges and obstacles on the Existing Design Guidelines for A&E Facilities

In this section information on the solutions on gaps, challenges and obstacles to the design guidelines is obtained in relation to the improvement design of the A&E facilities and quality of the healthcare services delivery are investigated

1. The gaps, challenges and obstacles constraining compliance to the DGAEF?

Appendix K: Observation location and times sheet

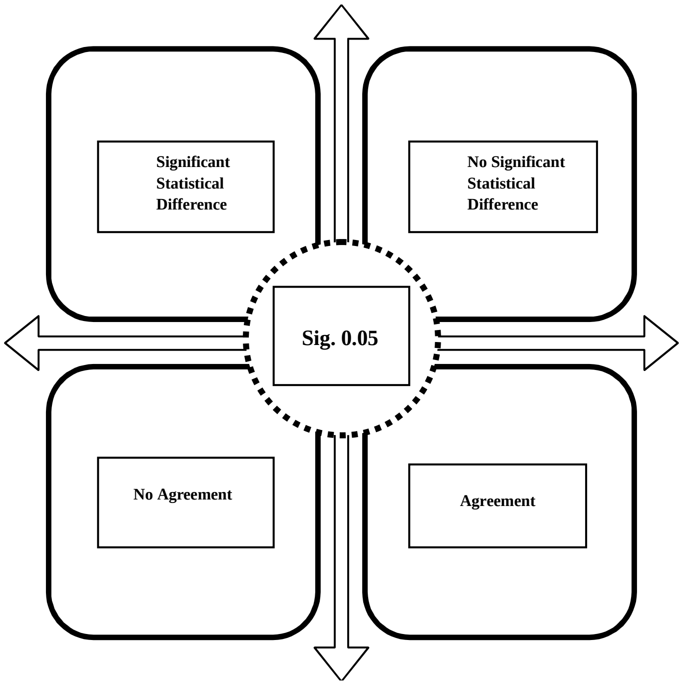
A&E facility: CHBH		**Observation sheet No. 1**		**Observation date 10/11/2007**	
Observation point (OP)	Morning (6am to 12am)	Afternoon (12am to 4pm)	Evening (4pm to 7pm)	Night (7pm to 00am)	Early-morning (00am to 6am)
OP1 position (in zone 1 main entrance)	**30mins**	**20mins**	**30mins**	**–**	**30mins**
OP2 position (in zone 1 main entrance)	**20mins**	**–**	**20mins**	**30mins**	**20mins**
OP3 position (in zone 2 examination area)	**40mins**	**30mins**	**30mins**	**20mins**	**40mins**
OP4 position (in zone 2 examination area)	**30mins**	**40mins**	**–**	**30mins**	**30mins**
OP5 position (in zone 3 treatment area)	**30mins**	**30mins**	**30mins**	**40mins**	**20mins**
OP6 position (in zone 3 treatment area)	**40mins**	**20mins**	**40mins**	**20mins**	**30mins**
Total hours	**170mins**	**120mins**	**150mins**	**140mins**	**170mins**

Appendix L: Observation continuous interval recording sheet

Sheet No. 1	**Date 10/11/2007**	**Weekday No. 1**	**Observation Zones A, B, and D**	**Observation code No. 1**
Task ID	**Event interval EI: 6am-12am**	**Observation points (OP) OP: ZA-01;ZB-03; ZD-09**	**Observation category (OC) OC: Caregivers/patients/family members/visitors**	
E 1, 2, 3, ….	**Event (E) (Events observed while the researcher was inside the unit)**	1. Patient walked in through the entrance and came to the desk; waiting lasted for approximately 90 minutes before he was moved to the examination area. 2. Caregivers recording the patients information and on the phone. 3. Computer related works/Charting 4. Family members/visitors talking with the caregivers, exchanging information 5. Waiting area was crowded lots of noise.		
MAP 1, 2, 3, ….	**Medical attention procedures (MAP)**	1. Non-Patient received treatment after 60 minutes, and left the examination area. 2. Emergency patient was treated after 180 minutes referred to radiology unit. 3. Caregivers continuously walking from the circulation areas to the stores, sluice and the examination/treatment. 4. Caregivers bringing in and out trolleys and equipment. 5. Giving medical attention to patient requires completing lots of tasks for the caregivers/physician, movement within the space/equipment requires attention 6. Physician on the mobile phone and occasionally talking to the patient		
BEV 1, 2, 3, …	**Built environment Variable (BEV)**	1. Adequate space lacking for the nature of caregivers operations. 2. Natural daylight in the examination rooms insufficient. 3. Artificial provided requires high lighting levels for complex visual tasks 4. Lack of space to accommodate examination trolleys/charts/equipment 5. Lack of privacy and dignity in examination/treatment spaces; private information given is heard by others.		
C 1, 2, 3, ….	**Caregiver (C)**	1. No decentralised caregivers support spaces for charting/supplies/medications. 2. Caregivers always walking in the unit from one space to the other before the completion of each of their daily work shift tasks. . 3. Caregivers giving information on the phone and attending to the family member of the patient in the unit. 4. Caregivers continuously interacting with the physical environment 5. Moving/relocating of the trolleys/equipment from the examination/treatment 6. Interaction with the patient not often except for medical treatment		
P 1, 2, 3, …	**Patient (P)**	1. Limited access to the features in the physical environment, for example, temperature control/television/phones. 2. Examination/treatment in cubicle floor plan configuration. 3. Access to the general ablution facilities far away from the examination/treatment spaces 4. Poor surveillance of the patient in the examination/treatment spaces by the caregivers		
FM 1, 2, 3, ….	**Family member (FM)**	1. No family zone in the examination/treatment spaces. 2. The floor plan configuration does not encourage family participation during medical attention to the patient. 3. Bereaved family members and visitors in the corridors crying. 4. Family members and visitors interaction with the caregivers in the corridors		
V 1, 2, 3, ….	**Visitor (V)**	1. Constantly on phone and eating in the corridors and walking and out of the unit. 2. Most of the visitors prefer waiting outside the unit. 3. Limited communications with the caregivers; most communication with the caregivers are related with the directional signs. 4. Frequent access to the examination/treatment spaces, no doors in these areas.		

Appendix M: Sample of ANOVA statistical tests at CHBH and PAH A&E Facilities

ANOVA—analysis of variance— is a statistical method of analysis that explores the predictability of the sample value.



(i) *P-value greater than 0.05*: If the probability value (p- value) is greater than 0.05, the null hypothesis is accepted and the result is not statistically significant.

When the p- value in each case is less than or equal to 0.05, it can be inferred that the factor (stakeholder in this case) has a significant effect on the dependent variable. Or it can be said that there is a significant difference in the opinions of the three groups as to the dependent variable. Thus, the lower the p-value, the less likely the result is if the null hypothesis is true, and consequently the more "significant" the result is, in the sense of statistical significance, i.e. that it is unlikely to have occurred by chance. Hence, if the sampling was done randomly, and if the sample size is large enough, then the results from this can be generalized to the entire population from which the sample is drawn.

(ii) *P-value is less than 0.05*: If the p- value is less than 0.05 but greater than 0.01, the null hypothesis is rejected and the result is statistically significant.

(iii) *P-value is less than 0.01*: If the p-value is less than 0.01, the null hypothesis is rejected and the result is statistically significant beyond 1 per cent level. The probability associated with F is given in the final columns. A p-value of less than 0.05 shows that there is a statistical significant difference between the groups being compared (Foster, 1993).

(iv) *Mean Squares*: The "Mean Squares" are variances. The Mean Square is found by dividing the sum of squares by the degrees of freedom. Thus for Q50j: 51.630/2= 25.815.

(v) *Between Groups Mean Squares:* The "Between Groups Mean Square" (25.815 for Q50i) is the variance of the group means.

(vi) *Within Groups Mean Squares*: The "Within Groups Mean Square" is computed from the variances within all the groups. Thus the degrees of freedom in this case are the number of respondents-1 minus the number of groups-1. (N-1)- (k-1) for k groups= N-k. In the case of Q50j this is 375- 2= 373.

(vii) *F-value*: The F- value is calculated by dividing the Mean Square of Between Groups by the Mean Square of Within Groups. Thus for Q50j: 51.630/2= 21.214, in the case of Q50j.

Appendix N: Sample of ANOVA Statistical Test and Chi-Square Test

One- way Analysis of Variance

Dependent variables	Between/within groups	Sum of squares	df	Mean Square	F	p- value
Q20: What is the extent of the compliance with the existing DGAEF for among consultants?	Between Groups	1.943	1	1.943	2.745	.100
	Within Groups	107.621	152	.708		
	Total	109.565	153			
Q21: Is the A&E facilities designed with the DGAEF adequate to providing quality healthcare services delivery?	Between Groups	16.651	3	5.550	4.628	.003
	Within Groups	657.255	548	1.199		
	Total	673.906	551			
Q23: In your opinion, are maximum areas requirements in DGAEF adequate?	Between Groups	.080	1	.080	.084	.772
	Within Groups	147.218	156	.944		
	Total	147.297	157			
Q25: Do you think it is sufficient to deliver adequate A&E facilities	Between Groups	67.726	1	62.726	113.362	.000
	Within Groups	86.872	157	.553		
	Total	149.597	158			
Q27a: Time to construct: Level 1 (District Hospital)	Between Groups	.006	1	.006	.001	.973
	Within Groups	785.462	157	5.003		
	Total	785.468	158			
Q27b: Time to construct: Level 2 (Regional Hospital)	Between Groups	17.633	1	17.633	1.561	.213
	Within Groups	1773.875	157	11.299		
	Total	1791.508	158			
Q27c: Time to construct: Level 3 (Tertiary Hospital)	Between Groups	15.587	1	15.867	.550	.459
	Within Groups	4526.931	157	28.834		
	Total	4542.799	158			
Q28: Do you think that this is an efficient and effective timeframe?	Between Groups	0.000	3	.000	.001	.975
	Within Groups	5.899	541	.038		
	Total	5.899	544			

One- way Analysis of Variance

Dependent variable	Between/within groups	Sum of Squares	df	Mean Square	F	Sig.
Q30: Do the DGAEF used for space design allow for the provision of adequate facilities that would improve patient comfort in A&E facilities?	Between Groups	110.486	3	36.829	49.346	.000
	Within Groups	403.764	541	.746		
	Total	514.250	544			
Q49a: Inappropriateness of the general and specific requirements in the DGAEF	Between Groups	24.991	2	12.495	13.033	0.000
	Within Groups	357.602	373	.959		
	Total	382.593	375			
Q49b: Poor project brief systems	Between Groups	31.572	2	15.786	19.060	0.000
	Within Groups	308.097	372	.828		
	Total	339.669	374			
Q49c: Lack of standardization	Between Groups	71.034	2	35.517	32.742	0.000
	Within Groups	405.693	374	1.085		
	Total	476.727	376			
Q49d: No feedback loop	Between Groups	23.054	2	11.527	10.420	0.000
	Within Groups	413.731	374	1.106		
	Total	436.785	376			

One- way Analysis of Variance

Dependent variable	Between/within groups	Sum of Squares	df	Mean Square	F	Sig.
Q49e: Lack of research in this field	Between Groups	37.507	2	18.754	18.413	0.000
	Within Groups	378.882	372	1.019		
	Total	416.389	374			
Q49f: Lack of post- occupancy evaluation system	Between Groups	41.806	2	20.903	16.513	0.000
	Within Groups	469.628	371	1.266		
	Total	511.433	373			
Q49g: Poor medium of communication tools for professional disciplines involved	Between Groups	41.825	2	20.912	18.300	0.000
	Within Groups	427.390	374	1.143		
	Total	469.215	376			
Q49h: Poor budget provision	Between Groups	63.366	2	31.683	23.953	0.000
	Within Groups	493.376	373	1.323		
	Total	556.742	375			
Q49i: Inconsistency in master plan of healthcare institution	Between Groups	58.391	2	29.195	19.859	0.000
	Within Groups	548.351	373	1.470		
	Total	606.742	375			
Q49j: Lack of design quality indicators for space design and provision, functional suitability and spatial relationships	Between Groups	45.334	2	22.667	17.106	0.000
	Within Groups	495.573	374	1.325		
	Total	540.907	376			

One- way Analysis of Variance

Dependent variable	Between/within groups	Sum of Squares	df	Mean Square	F	Sig.
Q49k: No demonstration projects	Between Groups	35.350	2	17.675	13.958	0.000
	Within Groups	471.050	372	1.266		
	Total	506.400	374			
Q49l: Lack of qualified healthcare consultants	Between Groups	26.543	2	13.272	11.652	0.000
	Within Groups	425.971	374	1.139		
	Total	452.515	376			
Q49m: Provincial Department of Health	Between Groups	8.632	2	4.316	3.887	0.021
	Within Groups	415.230	374	1.110		
	Total	423.862	376			
Q49n: Provincial Department of Public Works	Between Groups	10.360	2	50180	5.038	0.007
	Within Groups	383.512	373	1.028		
	Total	393.872	375			
Q49o: National Department of Health	Between Groups	12.081	2	6.041	5.591	0.004
	Within Groups	401.919	372	1.080		
	Total	414.000	374			
Q49p: Poor project technical documentation during project development phase	Between Groups	19.894	2	9.947	8.700	0.000
	Within Groups	425.295	372	1.143		
	Total	445.189	374			
Q49q: Subjective attitude and behaviour of the actors involved	Between Groups	26.612	2	13.306	10.717	0.000
	Within Groups	461.857	372	1.242		
	Total	488.469	374			

One- way Analysis of Variance

Dependent variable	Between/within groups	Sum of Squares	df	Mean Square	F	Sig.
Q49k: No demonstration projects	Between Groups	35.350	2	17.675	13.958	0.000
	Within Groups	471.050	372	1.266		
	Total	506.400	374			
Q49l: Lack of qualified healthcare consultants	Between Groups	26.543	2	13.272	11.652	0.000
	Within Groups	425.971	374	1.139		
	Total	452.515	376			
Q49m: Provincial Department of Health	Between Groups	8.632	2	4.316	3.887	0.021
	Within Groups	415.230	374	1.110		
	Total	423.862	376			
Q49n: Provincial Department of Public Works	Between Groups	10.360	2	50180	5.038	0.007
	Within Groups	383.512	373	1.028		
	Total	393.872	375			
Q49o: National Department of Health	Between Groups	12.081	2	6.041	5.591	0.004
	Within Groups	401.919	372	1.080		
	Total	414.000	374			
Q49p: Poor project technical documentation during project development phase	Between Groups	19.894	2	9.947	8.700	0.000
	Within Groups	425.295	372	1.143		
	Total	445.189	374			
Q49q: Subjective attitude and behaviour of the actors involved	Between Groups	26.612	2	13.306	10.717	0.000
	Within Groups	461.857	372	1.242		
	Total	488.469	374			

One- way Analysis of Variance

Dependent variable	Between/within groups	Sum of Squares	df	Mean Square	F	Sig.
Q50a: Review of DGAEF is long overdue	Between Groups Within Groups Total	22.613 372.522 395.135	2 374 376	11.307 .996	11.352	0.000
Q50b: Provincial Department of Health lack appropriate general and specific design requirements in the DGAEF for project briefing	Between Groups Within Groups Total	37.503 1215.399 1252.902	2 375 377	18.752 3.241	5.786	0.003
Q50c: Inefficient and ineffective information systems during pre and post project development phases of healthcare projects	Between Groups Within Groups Total	36.589 310.892 347.480	2 374 376	18.294 .831	22.008	0.000
Q50d:Assigning the project development process of A&E facilities projects to the National Department of Public works would improve their delivery	Between Groups Within Groups Total	1.813 532.575 534.387	2 374 376	.906 1.424	0.636	0.530
Q50e: Introducing design quality indicators obtained through research would improve space design and provision for A&E facilities	Between Groups Within Groups Total	35.577 374.031 409.608	2 375 377	17.789 .997	17.835	0.000
Q50f: Post occupancy evaluation documents and a continuous feedback culture is necessary	Between Groups Within Groups Total	41.204 458.027 499.231	2 374 376	20.602 1.255	16.822	0.000
Q50g: Healthcare projects are not completed within project programme and budgets	Between Groups Within Groups Total	65.963 455.379 521.342	2 374 376	32.982 1.218	27.088	0.000
Q50h: Development of standard project development standard tools should improve life- cycle costing	Between Groups Within Groups Total	18.944 468.080 487.024	2 374 376	9.472 1.252	7.568	0.001
Q50i: Sustainable design should be encouraged and rewarded	Between Groups Within Groups Total	61.249 440.100 501.349	2 372 374	30.624 1.183	25.886	0.000
Q50j: Project finance for healthcare facilities should be prioritized in order to meet MDG targets	Between Groups Within Groups Total	51.630 453.900 505.529	2 373 375	25.815 1.217	21.214	0.000

Chi- square Tests for Binary variables

Dependent variables	Responses	Frequency/Groups	Respondents Category					Chi- Square Tests		
			Consultants	Caregivers	DoH/PW	Patients	Total	Chi-Square	df	p-value
Q16: Are car park, taxi, bus stops and entrances easy to find and located close to the A&E building?	Yes	Frequency	53	115	47	132	347	27.634	3	0.000
		% of Group	15.27%	33.14%	13.54%	38.04%	100.00%			
	No	Frequency	26	109	27	40	202			
		% of Group	12.87%	53.96%	13.37%	19.80%	100.00%			
Q17: Are entrance approaches to surrounding areas welcoming and easy to find?	Yes	Frequency	54	103	59	126	342	43.914	3	0.000
		% of Group	15.79%	30.12%	17.25%	36.84%	100.00%			
	No	Frequency	25	121	16	46	208			
		% of Group	12.02%	58.17%	7.69%	22.12%	100.00%			
Q18: Are you familiar with the DGAEF?	Yes	Frequency	35	66	59	78	238	50.949	3	0.000
		% of Group	14.71%	27.73%	24.79%	32.77%	100.00%			
	No	Frequency	44	157	19	90	310			
		% of Group	14.19%	50.65%	6.13%	29.03%	100.00%			
Q22: In your view would the introduction of a fast track area in the update of DGAEF improve efficiency in healthcare services delivery?	Yes	Frequency	57	220	67	146	490	44.686	3	0.000
		% of Group	11.63%	44.90%	13.67%	29.80%	100.00%			
	No	Frequency	22	4	10	23	59			
		% of Group	37.29%	6.78%	16.95%	38.98%	100			
Q31: Are you in favour of introducing standard project development tools for A&E facilities with provision for minor changes?	Yes	Frequency	2	2154	0	0	217	350.041	2	0.000
		% of Group	0.92%	99.08%	0.00%	0.00%	100.00%			
	No	Frequency	78	5	78	0	161			
		% of Group	48.45%	3.11%	48.45%	0.00%	100.00%			
Q33: In your opinion would the use of technology (e.g. computer programmes, build information modelling and mock-ups) assist in the efficient and effective design of A&E facilities?	Yes	Frequency	69	219	66	0	354	22.471	2	0.000
		% of Group	19.49%	61.86%	18.64%	0.00%	100.00%			
	No	Frequency	10	2	9	0	21			
		% of Group	47.62%	9.52%	42.86%	0.00%	100.00%			

Chi- square Tests for Binary variables

Dependent variables	Responses	Frequency/Groups	Respondents Category					Chi- Square Tests		
			Consultants	Caregivers	DoH/PW	Patients	Total	Chi-Square	df	p-value
Q37: Do you think that a participatory approach in update of DGAEF will result in the design of a good healing physical environment?	Yes	Frequency	56	216	63	156	491	76.366	3	0.000
		% of Group	11.41%	43.99%	12.83%	31.77%	100.00%			
	No	Frequency	23	3	14	4	44			
		% of Group	57.27%	6.82%	31.82%	9.09%	100.00%			
Q38: Are internal circulation routes clear, efficient and convenient?	Yes	Frequency	32	96	27	75	230	2.807	3	0.420
		% of Group	13.91%	41.74%	11.74%	32.61%	100.00%			
	No	Frequency	43	115	49	87	294			
		% of Group	14.63%	39.12%	16.67%	29.59%	100.00%			
Q40: Do we need to provide for speciality facilities (e.g. chest pain unit, occupational health etc.) in A&E facilities?	Yes	Frequency	40	140	68	145	393	66.845	3	0.000
		% of Group	10.18%	35.62%	17.30%	36.90%	100.00%			
	No	Frequency	37	75	9	11	132			
		% of Group	28.03%	56.82%	6.82%	8.33%	100.00%			
Q41: Are you in favour of introducing general and specific design requirements in the DGAEF for private rooms in short stay wards in A&E facilities?	Yes	Frequency	33	55	43	89	220	42.425	3	0.000
		% of Group	15.00%	25.00%	19.55%	40.45%	100.00%			
	No	Frequency	48	165	33	76	322			
		% of Group	14.91%	51.24%	10.25%	23.60%	100.00%			
Q42: Can the introduction of general and specific design requirements in the DGAEF for private rooms in short stay wards in A&E facilities improve patient privacy and dignity?	Yes	Frequency	24	54	40	96	214	54.343	3	0.000
		% of Group	11.21%	25.23%	18.69%	44.86%	100.00%			
	No	Frequency	54	166	37	66	323			
		% of Group	16.72%	51.39%	11.46%	20.43%	100.00%			
Q43: Is it necessary to introduce general and specific requirements in the DGAEF for obstetrics and gynaecology space in A&E facilities?	Yes	Frequency	16	46	24	88	174	55.055	3	0.000
		% of Group	9.20%	26.44%	13.79%	50.57%				
	No	Frequency	63	174	53	73	363			
		% of Group	17.36%	47.93%	14.60%	20.11%	100.00%			

Chi- square Tests for Binary variables

Dependent variables	Responses	Frequency/Groups	Respondents Category					Chi- Square Tests		
			Consultants	Caregivers	DoH/PW	Patients	Total	Chi-Square	df	p-value
Q44: Is it necessary to introduce general and specific design requirements in the DGAEF for paediatric space in A&E facilities	Yes	Frequency	16	55	30	94	195	58.134	3	0.000
		% of Group	8.21%	28.21%	15.38%	48.21%	100.00%			
	No	Frequency	63	166	47	64	340			
		% of Group	18.53%	48.82%	13.82%	18.82%	100.00%			
Q45: Is it necessary to introduce general and specific design requirements in the DGAEF for psychiatric patients' space in A&E facilities?	Yes	Frequency	16	58	36	1	111	17.501	3	0.001
		% of Group	14.41%	52.25%	32.43%	0.90%	100.00%			
	No	Frequency	63	160	41	0	264			
		% of Group	23.86%	60.61%	15.53%	0.00%	100.00%			
Q46: Can the general and specific design requirements in the DGAEF limit innovation in space design and provision of A&E facilities?	Yes	Frequency	7	0	19	0	26	7.045	1	0.000
		% of Group	26.92%	0.00%	73.08%	0.00%	100.00%			
	No	Frequency	71	0	57	0	128			
		% of Group	55.47%	0.00%	44.53%	0.00%	100.00%			
Q48: Can appointment of consultants for A&E projects through competitive procedures influence compliance to DGAEF?	Yes	Frequency	11	0	50	0	61	40.974	1	0.000
		% of Group	18.03%	0.00%	81.97%	0.00%	100.00%			
	No	Frequency	64	0	26	0	90			
		% of Group	71.11%	0.00%	28.89%	0.00%	0.00%			

Appendix O: A Sample of Interview Transcriptions: Architect

Survey of the role of design guidelines (DGs) for Accident and Emergency Facilities (A&E) in South Africa

Semi- structured interview for Architects, Quantity Surveyor, Civil, Structural, Electrical and Mechanical Engineers

No. 1A	SN/I	Date: 04 January 2008	Time: 10.00 am	Location in which province the interview was conducted: Gauteng	Result code: A1	Personal Background of the interviewee: Architect: 67 years; Male; Education: University degree; Position: Director; Project: CHBH A&E Facility

Section A and B: Current DGAEF and The New Approach to DGAEF Review Based on Planetree Principles

Theoretical Framework 1: DGAEF as a medium of communication.

Research Assumption 1: Current DGAEF lacks appropriate information systems for developing good project development process (project brief, design solutions and construction systems) which is essential for building improved A&E facilities.

Questions	**Answers**	**Key Words**
Q.1 Are you familiar with the current DGAEF?	Yes I am. The current DGAEF are not comprehensive and do not provide for a demarcation between trauma and A&E. They also do not relate to size nor provide specific design requirements for the A&E facility. A comprehensive DGAEF document is needed which will provide for flexibility in the design by incorporating various evaluation and feedback mechanisms while providing for effective communication. Such guidelines are long overdue in South Africa.	- Guidelines for A&E facilities are not comprehensive -There is need for general and specific design requirements for trauma unit in A&E facilities -Review of the current DGAEF is long overdue
Q.2 Have you used this DGAEF before for space design and provision for healthcare facilities project development?		
Q.3 What is the extent of the current compliance with the current DGAEF amongst consultants?	Compliance is not high with the current DGAEF which are outdated are produce inaccurate results. However compliance with the R158 document, which is framework document developed independently by provincial department for private sector healthcare facilities, is quite high. The current DGAEF do not cater for specific types of equipment in various rooms in the hospital. This lack of integration may affect the effectiveness of the current DGAEF with respect to efficiency and effectiveness of the new facility. This makes it difficult for healthcare designers without enough experience to undertake any healthcare design.	-DGAEF compliance is not high -R158 compliance is high development framework used only in private sector facilities -The current is outdated -Design guidelines and norms should specify equipment types for all rooms

Q.9 How long does it take to construct the following healthcare facilities from project briefing to completion (level 1, level 2 and level 3)?-	It takes very long to construct these facilities from project briefing through to completion. The clients do not clearly define their requirements nor prepare proper briefs. The briefing processes, therefore, is long drawn because client departments lack capacity and the necessary skills to undertake this phase comprehensively, and this impacts on the ultimate project implementation period. The briefing and design period may take up to 3- 4 years and the construction phase 4-5 years depending on the level of care of the facility and availability of finance. On average a L1 facility may take 3 to 4 years, a regional healthcare facility (Level 2 and 3) on average 4 to 5 years and a tertiary facility, like the Pretoria Academic hospital, at least 15 years.	- Project brief is a key issue in A&E facility projects -Design and construction timeframe for A&E projects is unnecessarily too long -Average construction time for L1 and L2 facility 9 years -Average construction time for tertiary facility 15 years
Q.10 Do you think that this is an efficient and effective timeframe?	Highly ineffective. Shorter design and construction periods are better and should be included in the design guidelines in order to eliminate some of these huge cost variances. This will also result in effective evaluation of the completed projects and better feedback.	-Project implementation process is highly ineffective and inefficient -Shorter project timeframes -Elimination of huge cost variance is necessary Effective project evaluations and feedback
Q.11 Do you think the DGAEF are appropriate in relation to meeting the national need for A&E facilities?	Absolutely inappropriate in meeting the national healthcare facility needs for A&E facilities. These facilities are urgently needed in all our communities and need to be within accessible walking distances. Healthcare administrators lack the necessary skill to implement the projects. We spend approximately only 30% of the annual national and provincial budgets allocation on healthcare facilities projects respectively and this is due to lack of appropriate normative documents and inadequate implementation systems.	-Delays in construction works constrains the provision of A&E facilities -Under expenditure of the national/provincial government budget allocation for A&E facilities

Section A and B: Current DGAEF and The New Approach to DGAEF Review Based on Planetree Principles

Theoretical Framework 2: The effect of DGAEF on effective and efficient A&E facilities.

Research Assumption 2: Current DGAEF constrains the quality health care services delivery

Questions	**Answers**	**Key Words**
Q.4 Can A&E facilities designed with the current DGAEF facilitate quality healthcare services delivery?	They are not adequate and more so for public facilities. Private sector facilities seem to maintain a certain standard of healthcare services delivery. The recent proposal by the Health Minister to merge both private and public healthcare system may end up paralysing both systems leading to an absence of effective healthcare facilities in the country. It is in this regard that we need design norms to address all the constraints in facility design. I think private healthcare facilities are currently under pressure, especially those around Johannesburg.	-Healthcare services delivery inadequate -Private sector facilities under pressure

Q.12 Do the current DGAEF used for space design allow for the provision of adequate facilities that would improve patient comfort in A&E facilities?	No, they do not. It is one of the reasons why we do A&E upgrades all the time.	A&E facilities are not staff/patient friendly
Q.16 In which areas do you think that the current DGs need to be improved for more efficient use of A&E spaces?	Yes introduction of areas for social interaction is necessary. Statutory guidelines could facilitate this. This may result in additional costs but is necessary and will provide value for money; and so should be included in the budgets. Provision of areas such as a resource centre, children entertainment zones and a patient/family waiting area is an important space requirement for quality healthcare services delivery.	-Introduction of social space is necessary -Additional cost is an issue but will translate to value for money
Q.19 Are internal circulation routes clear, efficient and convenient?	In the facilities that I have designed internal corridors are effective and efficient although in some instances transfer patients pass through the consulting /treatment rooms from public corridors. Guidelines to deal with this problem are required. Introduction of separate circulation system is necessary to enhance caregivers operations and quality of services delivery.	Transfer of the patient still through public corridors -Internal circulation system acceptable
Q.20 If no, how can design guidelines in the current DGAEF improve internal accessibility with minimum walking distances?	Internal circulation for A&E facilities may be efficient but is not effective. Staff/patients/public still walk long distances. Introduction of guidelines to reduce walking distances is important in order to have an effective and efficient healthcare facility. The scale of these buildings should be carefully considered during design concept stages. The internal circulation routes could be animated like in the high streets to reduce the effect of long walking distances.	-Long walking distances -Review of the current functional concept for A&E facility -Creative interior concept for internal circulation systems for the A&E facility
Q. 21 Can DGAEF contribute positively to improving the following patient special needs: Access to social spaces for interaction; reduction of human and equipment noise levels?	The A&E is generally a noisy environment due to hard reflective floor finishes with nurses chatting either with colleagues or patients. Reduction of human noise levels and reduction of equipment noise level is necessary and important. Modern healthcare facilities in USA and Europe now encourage the use of multi-purpose or functional rooms for consultation/treatment. This solution may assist in elimination of patient transfers and a proportional reduction in equipment noise levels. Granting patient access to room temperature and light control should be a nice to have. The design norms we are using now are completely outdated. Access to information technology is not available at the moment should be provided. Other items that should be provided for include access to social space for interaction, easy surveillance of patients/families by caregivers, access for the physically challenged people and adequate grieving spaces.	-Reduction of human/equipment noise -Access to room temperature and light control to patient -Surveillance to patient/families in the waiting areas -Norms for physically challenged Grieving spaces not adequate

Section A and B: Current DGAEF and The New Approach to DGAEF Review Based on Planetree Principles

Theoretical Framework 3: Participatory approach process for DGAEF review and for project development is required;

Research Assumption 3: Participatory and integrated approach in review of the current DGAEF would encourage continuous improvement of the project development process essential for effective and efficient A&E facilities;

Questions	Answers	Key Words
Q.15 Do you think that a participatory approach in review of current DGAEF will result in the design of improved A&E facilities?	Yes. A participatory approach is very important and all relevant stakeholders should be consulted. The healthcare facility must be owned by the community at large. The resident and non-resident community must have a say on the type, required services need and the overall design. The participants will be the National/Provincial Department of Health, the National/Provincial Department of Works, (maybe) staff from the National/Provincial Department of Education, the professional team (i.e. Architects/Engineers/Other Consultants), Caregivers, Doctors, Nurses, Patients and any interested members of the community.	-A&E facility must be owned by the community -National/Provincial health -Education -Finance -Professional team -Academics -Caregivers -Patients -Community

Section A and B: Current DGAEF and The New Approach to DGAEF Review Based on Planetree Principles

Theoretical Framework 4: Technology innovation and updates through DGAEF review;

Research Assumption 4: Review of the current DGAEF with emphasis on technology innovation would improve project development processes and compliance by all stakeholders (consultants, government and healthcare institutions)

Q.22 Does general and specific design requirements in the DGAEF limit innovation in space design and provision of A&E facilities?	Statutory guidelines and norms will not limit innovation. The current guidelines are incomplete and actually limit creativity. In my opinion we need a comprehensive normative document, and not a framework like the R158.	-Norms do not limit innovation -Current norms are incomplete -Current norms limits creativity and innovation
Q.15 In your opinion would the use of technology (e.g. computer programmes, build information modelling and mock-ups) assist in the efficient and effective design of A&E facilities?	I think it gets back to the standardisation of the project documentation and this will be very useful. The use of computer in determining the facility needs, ideal zoning and functional layout plans will be great to all stakeholders. I think that if we have appropriate software for solving these problems documentation timeframe may be reduced drastically. I also think that we have very few design professionals in this field. Another major frustration is still with approval and the tender process.	-Technological assistance for zoning and functional layout plans -Software not available -Few design professional in this field

Section A and B: Current DGAEF and The New Approach to DGAEF Review Based on Planetree Principles **Theoretical Framework 5:** The role of DGAEF on institutional transformation and change **Research Assumption 5:** New DGAEF can influence change in attitude and behaviour of the key actors involved in project development process and institutional transformation and change		
Q.5 In your view would the introduction of a fast track area in the review of current DGAEF improve efficiency in healthcare services delivery?	The concept is good if introduced in A&E facilities for the walking patients and would be preferable in the admissions area close to the triage or near the information desk.	-Fast track space for walking patient -In admission area -Near the admission desk -Close triage area
Q.14 In which of these areas do you think that introduction of "adaptable" and "flexible" standard project development tools would improve efficient and effective use of resources (*examination area, stretchers examination area, treatment area, resuscitation area, counselling area and triage area*)?	An A&E facility is one of the hospital departments that require constant change in space use. I will support the introduction of adaptable and flexible space in the design guidelines for A&E it will be a good idea to have it in the examination areas, treatment, triage and counselling.	-Adaptable and flexible space is necessary -In examination area -In treatment area -In triage area -In counselling area
Q.29 Which of these measures, if introduced, would promote compliance to the current DGAEF amongst consultants; Good design brief, Ease of use design norms, Adaptability, Obligation and Reward and Design Quality Indicators (DQIs)?	In public sector healthcare facility design, most of our problem is that we are not getting adequate brief from the client. A Good design brief is essential. Adaptability is Absolutely important if we want to promote compliance. Every architect has the obligation to adhere to the clients brief. Good execution of professional duties attracts more works and awards.	-Good design brief is essential -Adaptability is important for sustainable design solution -Execution of professional duty is an obligation
Q.30 Can appointment of multidisciplinary project team for healthcare facilities projects through competitive procedures influence compliance to DGAEF?	Interesting question. Absolutely the current Government procurement system for healthcare design does not allow for competitive design proposals because of the affirmative statutory laws. If introduced compliance to any good design norms may be high. In Germany most public sector appointments are based on design completions. Competitive procedures are very good for public sector procurement systems.	-Competitive design proposal lacking -Compliance will increase with competitive procurement system -Design quality increase with competitive public sector appointment

Section A and B: Current DGAEF and The New Approach to DGAEF Review Based on Planetree Principles **Theoretical Framework 6:** Standardisation of the project development process and life-cycle costing **Research Assumption 6:** Introduction of standard project development systems would facilitate the building of effective and efficient A&E facilities		
Q. 6 In your opinion, are current maximum areas requirements in the current DGAEF adequate?	Completely inadequate. About 120% less depending on patient profile again. I think the emphasis needs to be based on community demographics in theory…. The difference also is definitely between public and private sector hospitals ……, because Milpark, which is a 350 bed facility private healthcare, has a good A&E facility….Whereas Baragwanath, which has the same specialists, with about 3000 bed has an inefficient A&E facility… I hope they will address this issue with the new facility currently under construction….I guess in private time is money, and spaces are effectively and efficiently designed and utilised.	-A&E space allocation in current norms inadequate -A&E space allocation 120% less than current requirement -A&E space allocation for private sector adequate
Q.7 What is the average current cost per square metre using the current DGAEF?	Generally public sector spends about USD 3000 per square metre or about USD 200 000 per bed….In private sector facility we will be working from about USD 2000 per square meter or USD 100 000 per bed…Healthcare buildings are generally very expensive….If delays caused by the absence of appropriate design guidelines and lengthy approval process are added to the above cost…..certainly the above cost will triple for public sector facility…. At times this cost may escalate to five times the market price….a good example is Pretoria academic hospital.	-Public spends USD 200 000 per bed -Private r spends USD 100 000 -Additional cost for between three to five time the estimate
Q.8 Do you think that the budget allocations for A&E facilities are currently effectively spent?	In private sector definitely….I think public funds are ineffectively spent, because there is a lack of a briefing tool and ineffective approval procedure…. Health department do not really know what they need and doing…. it takes about 4 or 5 years to get something going…By the time these facilities are built they are probably already 5 years out of date.	-Budget poorly spent -Facilities outdated on completion -
4	It is a tough question….It is like shooting yourself in the foot...Less professional fees…Yes it is a good idea…Everyone will know the required standard…Provided that there is room for improvement …If this condition is the design guidelines I will support the idea…It will reduce design and approval timeframes…Yes it would solve a lot of department of health problems in terms of design briefing, procedural issues and skills shortage in the industry.	-Standard layout plans -Reduction of documentation time -Important for approvals -Briefing issue -Will address skill shortages

Q.23 Are you in favour of introducing general and specific design requirements in the DGAEF for private rooms in short stay wards in A&E facilities?	No, I think we do not need private rooms in the short stay wards in A&E facilities…I know that design philosophy for wards now favours private rooms… Do they have the money and staff for such facilities…In terms of infection control hard evidence has shown that private rooms concepts reduces this problem.…Eventually this new approach will be implemented in future in South Africa…For now I think a design norms that eliminates and addresses the design gaps is what is required…if they want to include private rooms in guidelines it is fine if they have the resources….Another issue to consider should be whether patients are allowed to stay in A&E for a long time …you should ask the caregivers I think their opinion on this issue is very relevant.	-New guidelines to focus urgent needs -Lack of funds -Lack of staff -Caregivers opinion is very important on the issue
Q.24 Can the introduction of general and specific design requirements in the DGAEF for private rooms in short stay wards in the A&E facilities improve patient privacy and dignity?	Yes, of course as I said before let the hospital staff decide on what works better for their operations…Certainly, private spaces will solve such issues like patient privacy and dignity….However, I think that the turnaround time in A & E is much too quick for private wards….Long stay patients who need private space should be admitted in the main hospital if such facilities are available…	-Patient privacy and dignity is an issue -Turnaround time too quick to allow for private rooms
Q.25 Is it necessary to introduce general and specific design requirements in the DGAEF for obstetrics and gynaecology space in A&E facilities?	Yes, but this cases should be dealt with in the obstetrics and gynaecology spaces…before transfer to a specialised unit…I think these spaces should be provided for in the A&E facilities…Usually these cases happens late at night …imagine in communities without dedicated mother and child facility design norms should allow for obstetrics and gynaecology spaces.	-Obstetrics and gynaecology spaces to be introduced
Q.26 Is it necessary to introduce in the general and specific design requirements in the DGAEF for paediatric space in A&E facilities?	There are no guidelines that deal specifically with paediatric areas in the current norms. There are cases of over or under-design of this unit in many A&E buildings. These guidelines are necessary more so in the paediatrics unit.	-Guidelines for paediatrics not available -Paediatrics unit guidelines for A&E necessary
Q. 27 Is it necessary to introduce general and specific design requirements in the DGAEF for psychiatric patients' space in A&E facilities?	Yes, new design guidelines for psychiatric facilities are needed.	-Review of the guidelines required

Appendix P: Results of the CHBH accident and emergency facility floor plan analysis

The basic relationships between adjacent areas and their spatial properties were evaluated using floor plan analysis approach with HTA, LA and Space Syntax techniques explained in detail in Chapter Four (see 4.7).

The floor plans at the CHBH and PAH A&E facilities were categorised into four key functional zones as follows: ZONE A (entrances, waiting, triage and pre-examination); ZONE B (examination and treatment areas); ZONE C (inpatient areas); ZONE D (support areas: administration, pharmacy, staff areas and visitors areas). The events that occur in these zones were evaluated against the following DQIs: space design and provision; functional suitability/utilisation and spatial relationships.

Space design and provision: The design variables that have the greatest influence on space design and provision are: spatial organisation and openings/walls penetrations. These were evaluated and scored low, medium or high. Continuous observation interval recording sheet in combination with LA were used to evaluate the impact of the DGAEF used for the project implementation on the actual space provision and design of CHBH and PAH A&E facilities. Space organisation and openings/walls penetrations were analysed using HTA and LA to evaluate the following: space articulation[168] and inflection[169]; placement[170]; circulation; massing and geometry. The criteria for evaluating the design of openings/walls penetrations in this facility focused on two design quality indicators used to evaluate the degree of architectural interior permeability: (i) disclosure[171] and (ii) mobility[172].

[168] Articulation measures the degree of modification of spatial organisation from planes or volumes by their skilful modulation into clearly expressed subparts to facilitate legibility add interest, afford order and rhythmic composition (Rengel, 2007)

[169] Inflection measures the degree of deviation from a given spatial organisation for instance when a straight scheme becomes angular or curved (Rengel, 2007)

[170] Placement measures the spatial arrangement of functions and relationships to each other based on HTA. Public areas should generally be in front while private areas can be to the rear, and shared services centrally located (Rengel, 2007)

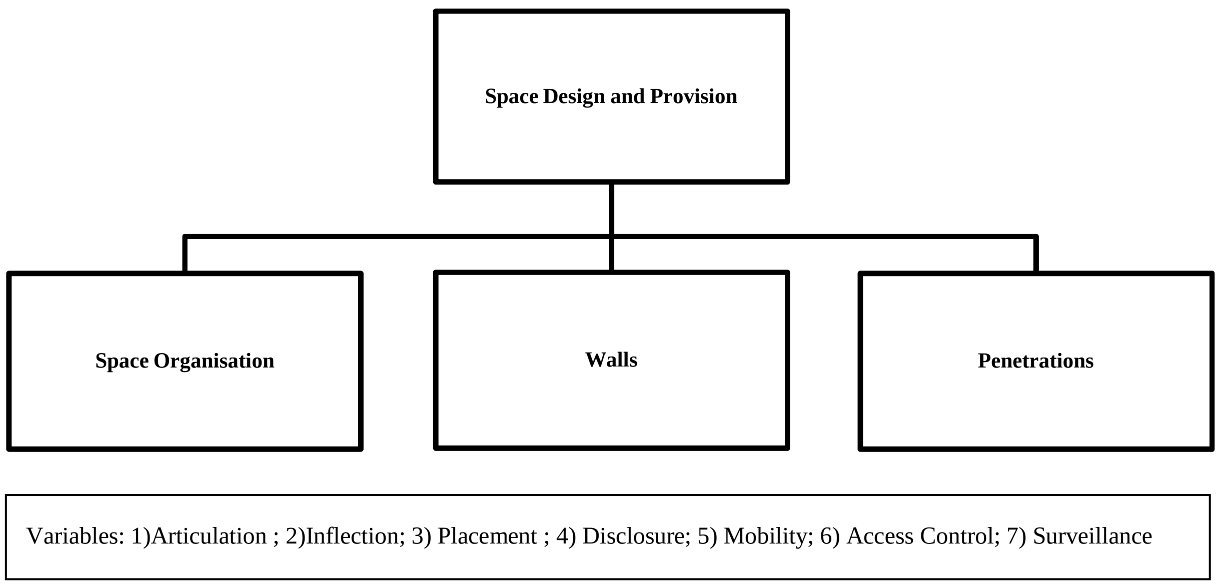
[171] Disclosure measures the degree to which a space and other spaces beyond are revealed as one moves within and around a defined space. The level of visual disclosure are determined by the number, type and placement of view-obstructing elements, whether they are permanent architectural elements or less permanent elements, such as furniture, equipment or plants (Rengel, 2007)

[172]Mobility measures the relative degree of freedom or restraint a particular spatial arrangement affords those who move within and around a defined space. Designers can control people's movement within a building system. The degree of freedom or restraint is determined by the floor plan configuration and the access and exit options it offers (Rengel, 2007)

Functional suitability and utilisation: The four most important issues to be considered when analysing functional suitability and space utilisation are: space use and occupancy level; space activities/workflow process and access/circulation/time. These issues were recorded in the continuous observation interval recording sheet using the following measures: HTA/LA; entrance/exist counts; space use occupancy survey and staff and patient pathways. The findings are discussed in Chapters Six and Seven:

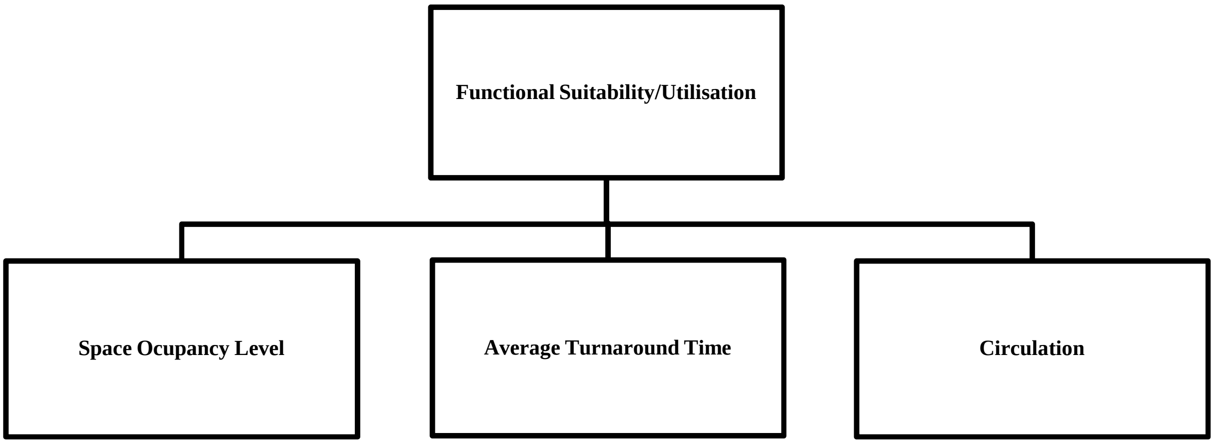
Spatial relationships and internal experience: DQIs were defined in the Participant Observation Data Collection Protocol Sheet used to collect information to evaluate spatial relationships and internal contextual experience. A design quality scoring system—low, medium, and high—was used to evaluate: adjacency matrix; level of autonomy[173]; internal finishes; quality of natural/artificial light and use of colour/texture. The findings are discussed in Chapters Six and Seven.

Figure 1.1: DQI−Space design and provision



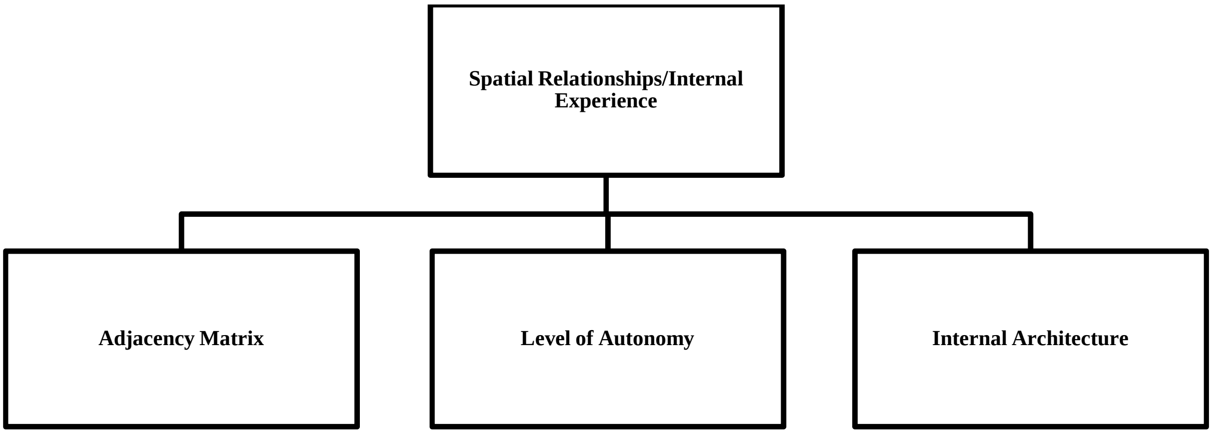
[6] Level of spatial autonomy measures the relative degree of connection and integration between spaces. There are various ways of joining spaces: no physical connection; off-side connection; direct connection; in-between connection; interpenetrated connection and semi-imposed connection. Level of connection influences the level of individual or group activities within a space and besides defines the level of interaction (Rengel, 2007)

Figure 2.1: DQI−Functional Suitability/Utilisation



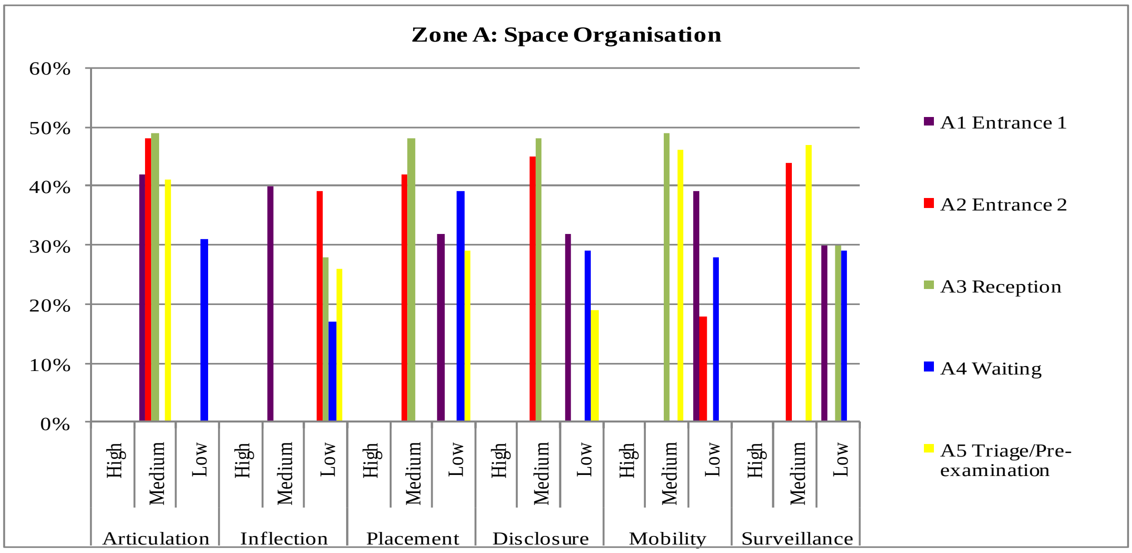
Variables: 1) Room entrance/exist counts; 2) Room profiles; 3) Pattern of movement of caregivers Mobility

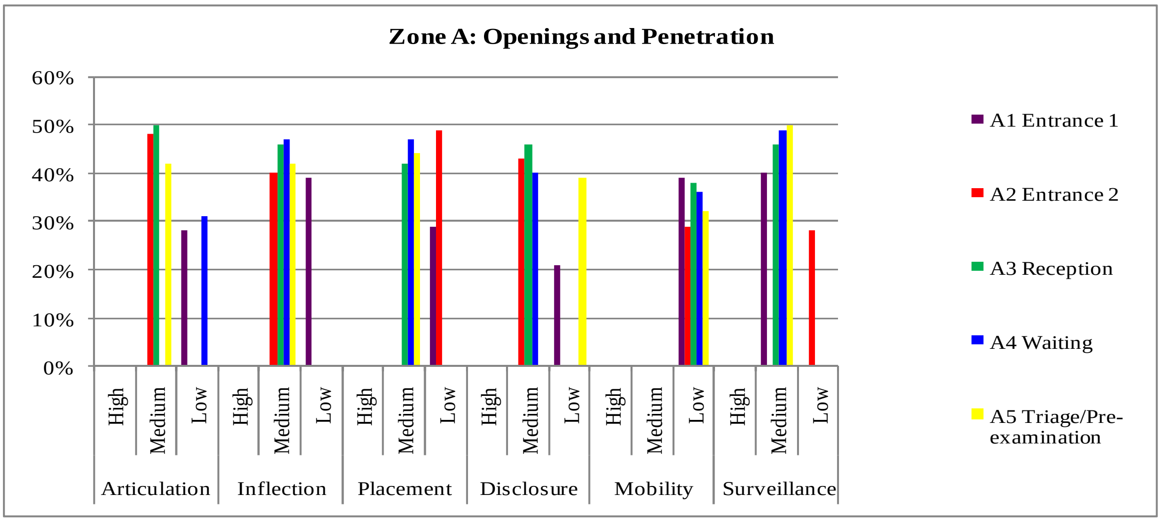
Figure 3.1: DQI−Relationships/Internal Experience

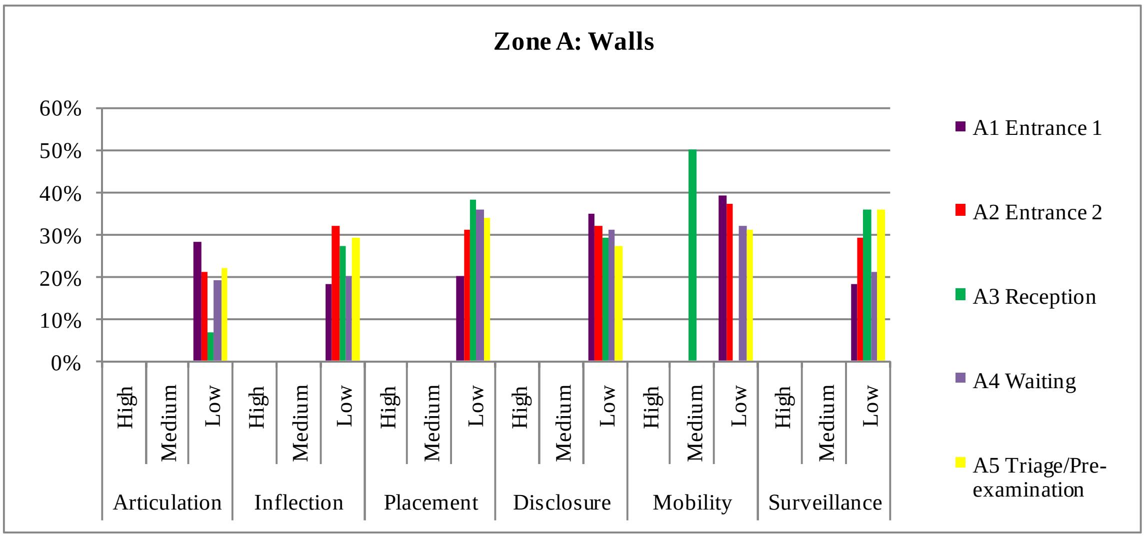


Variables: 1) Location of ancillary areas; 2) Internal spaces closure; 3) Visual/auditory; 4) Privacy and dignity; 5) Quality of natural/artificial; 6) Use materials/Colours

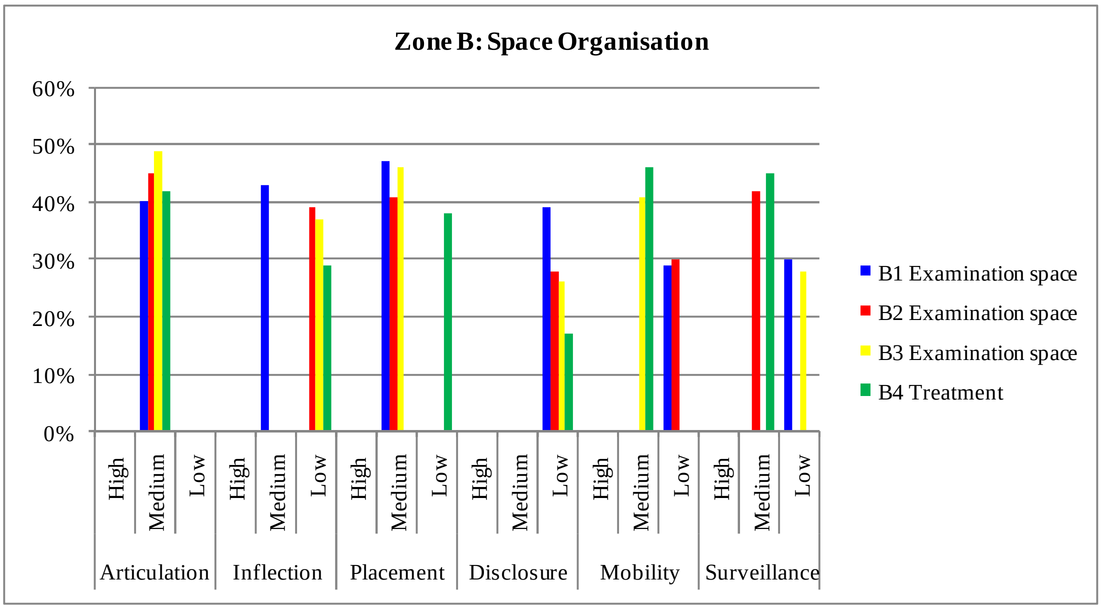
Appendix P: Results of the CHBH accident and emergency facility floor plan analysis

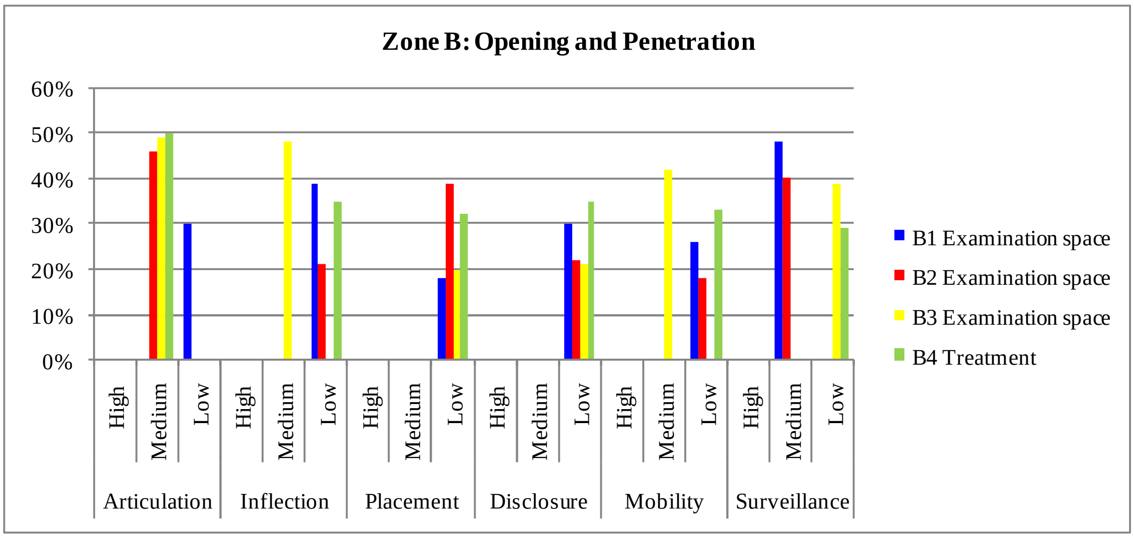


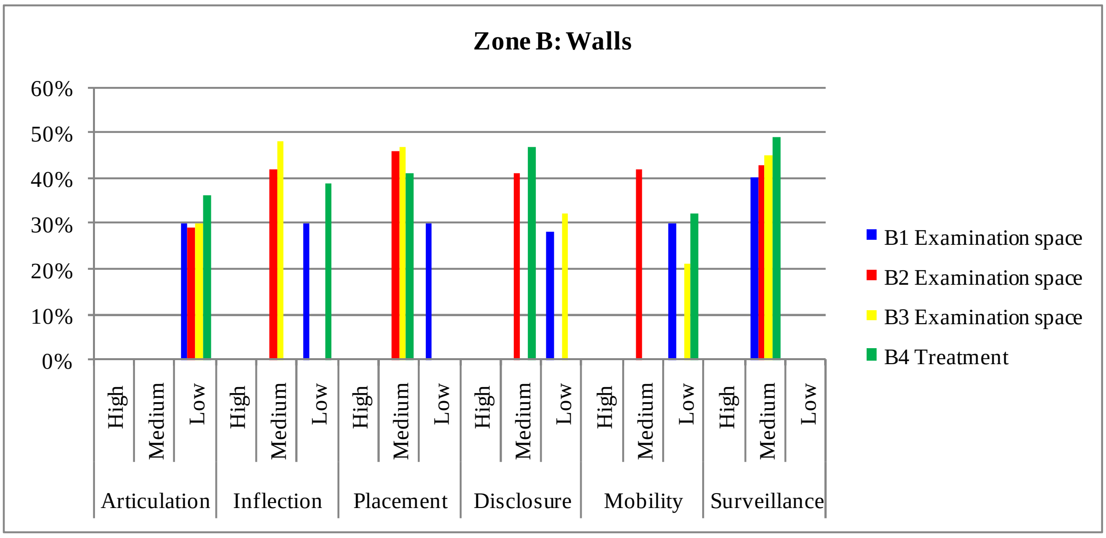




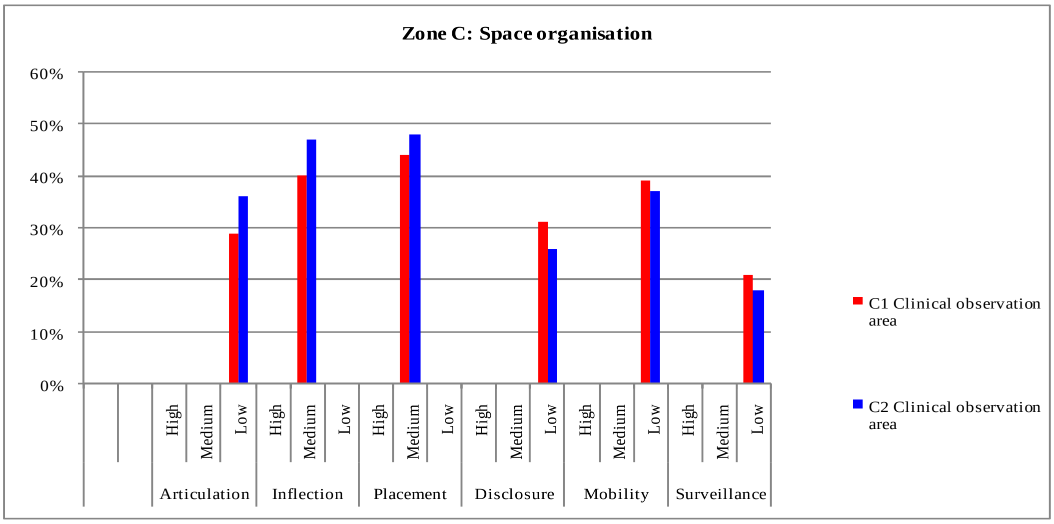
Appendix P: Results of the CHBH accident and emergency facility floor plan analysis

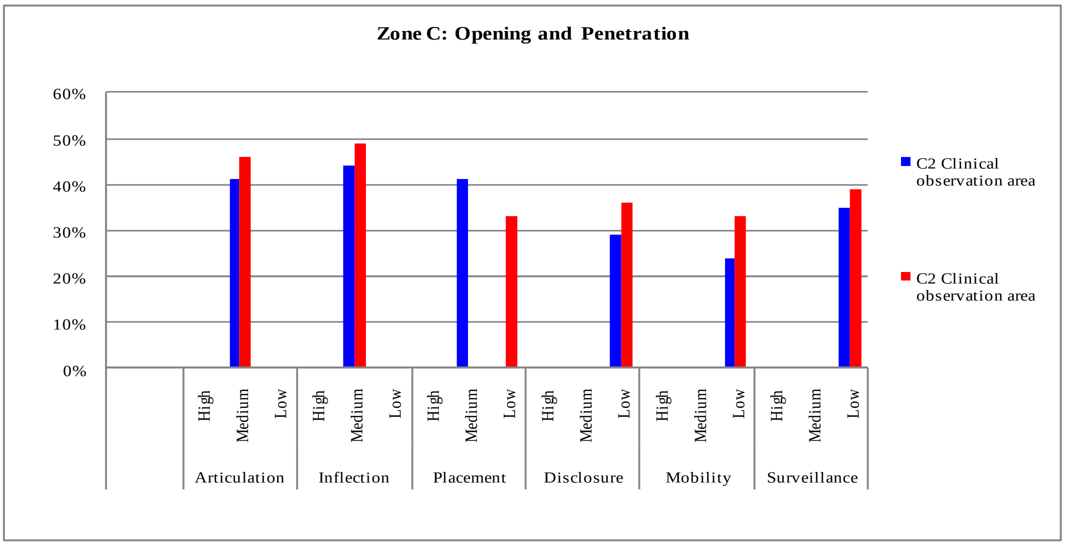


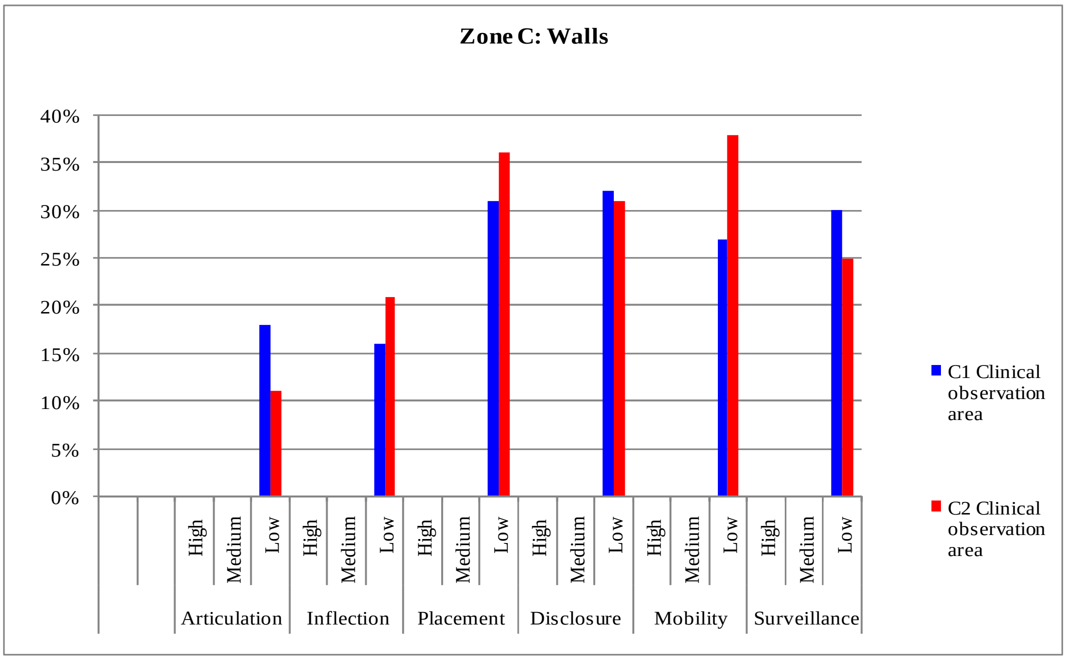




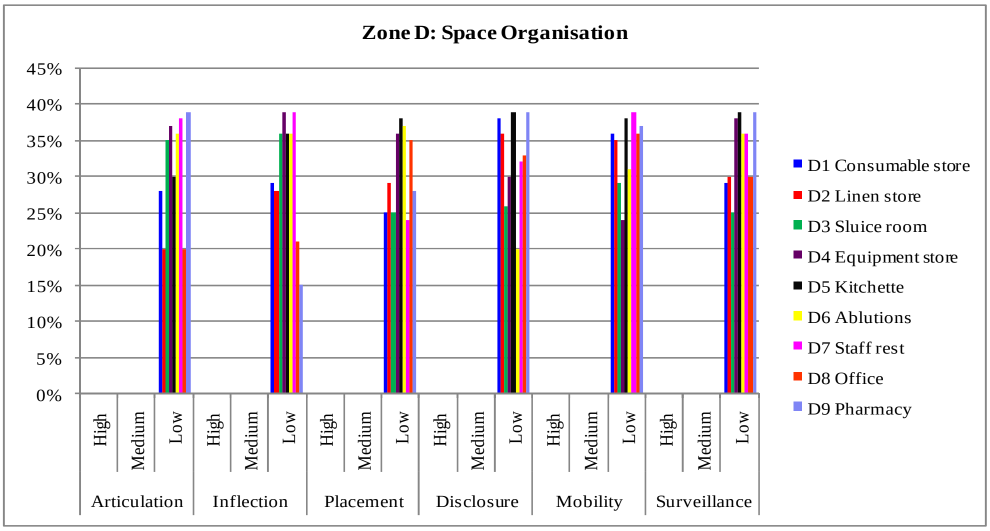
Appendix P: Results of the CHBH accident and emergency facility floor plan analysis

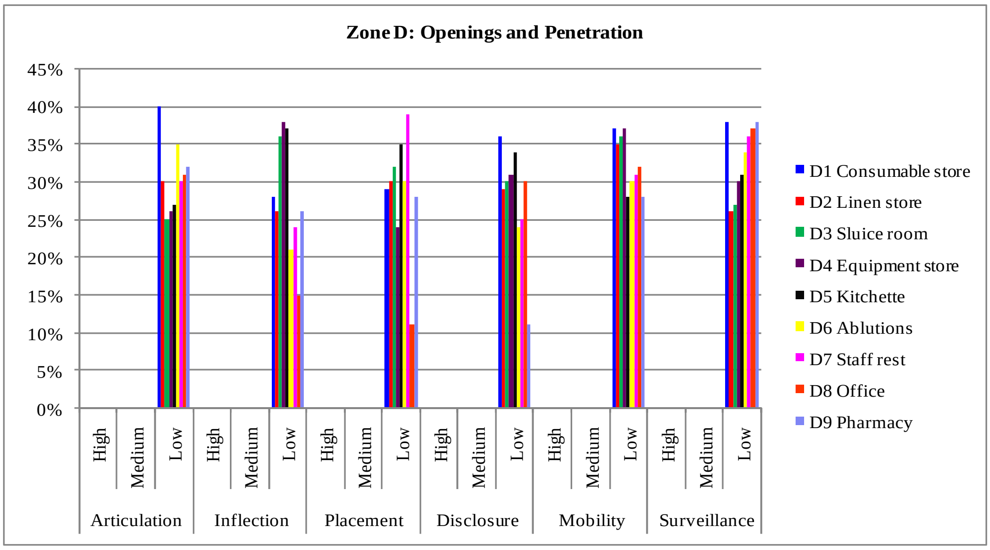


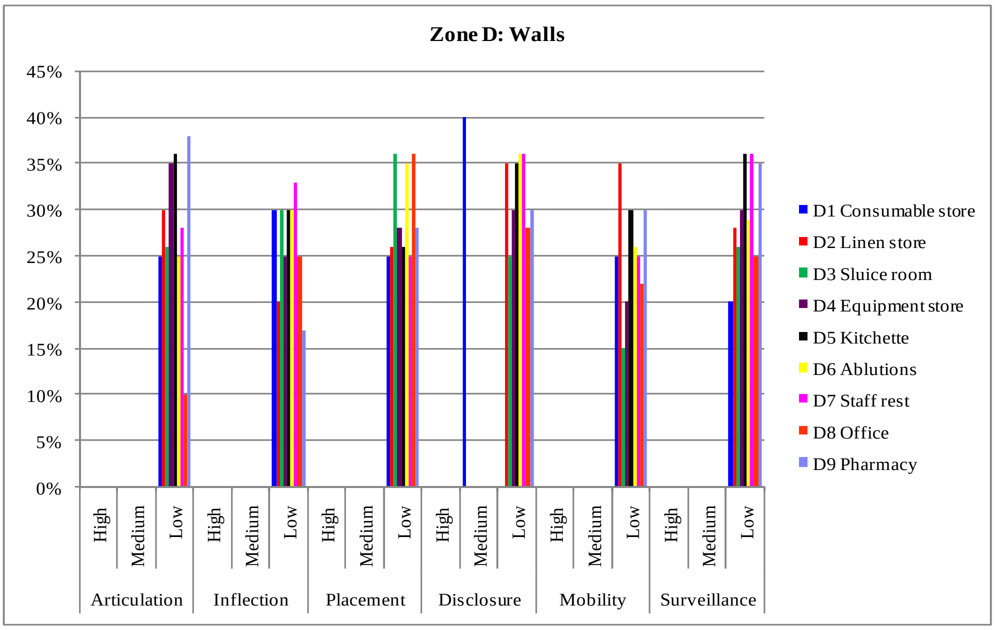




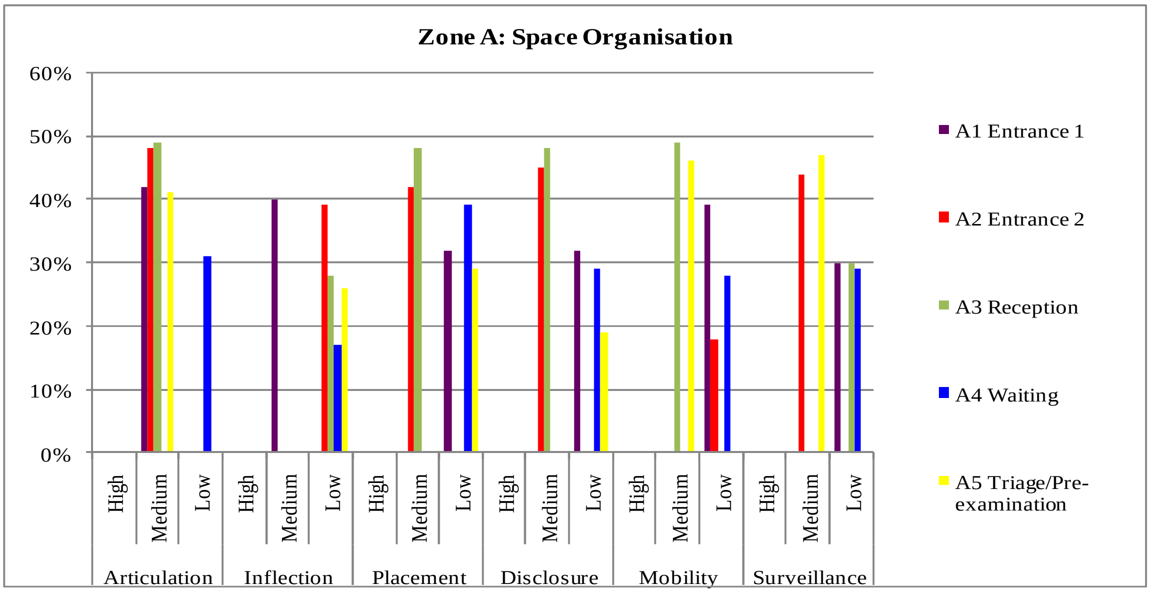
Appendix P: Results of the CHBH accident and emergency facility floor plan analysis

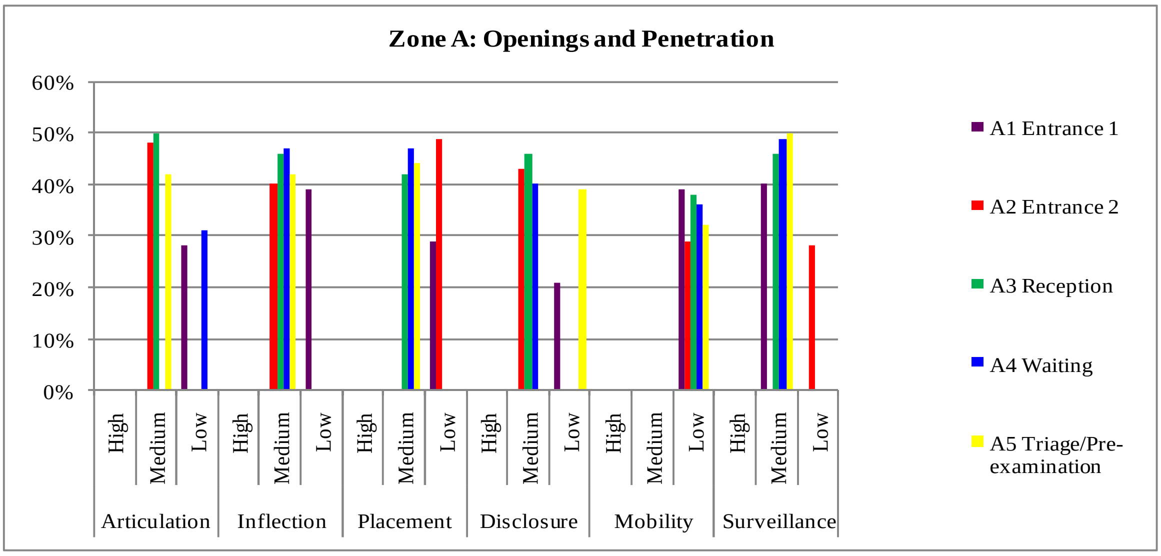


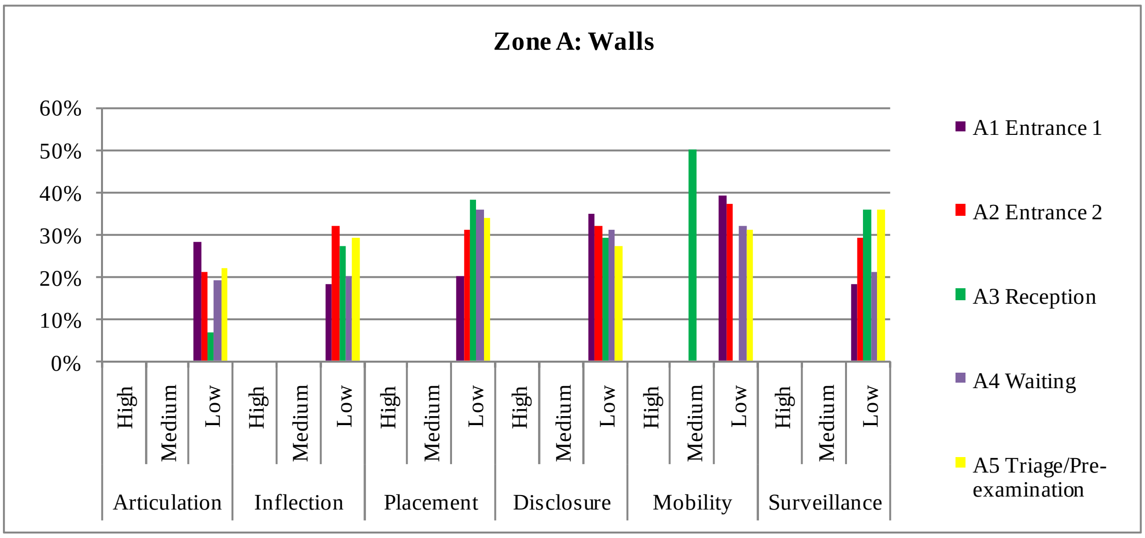




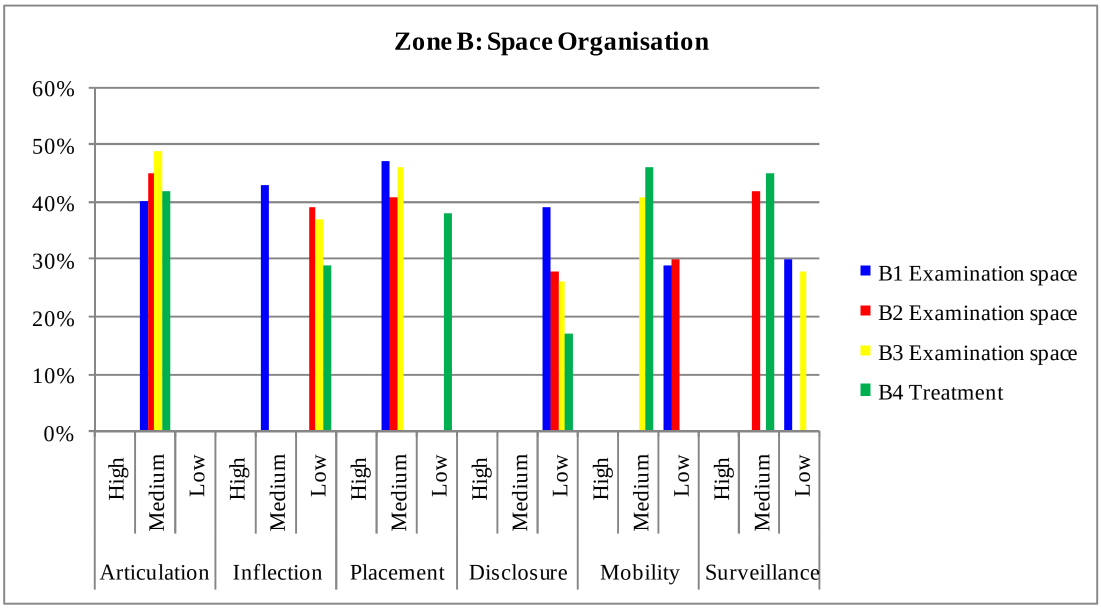
Appendix Q: Results of the PAH accident and emergency facility floor plan analysis

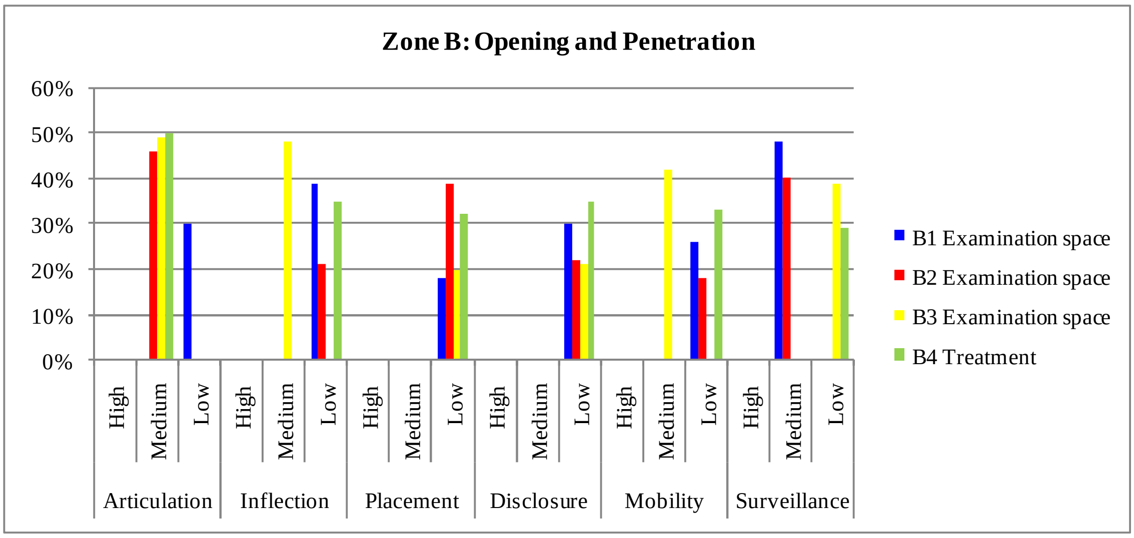


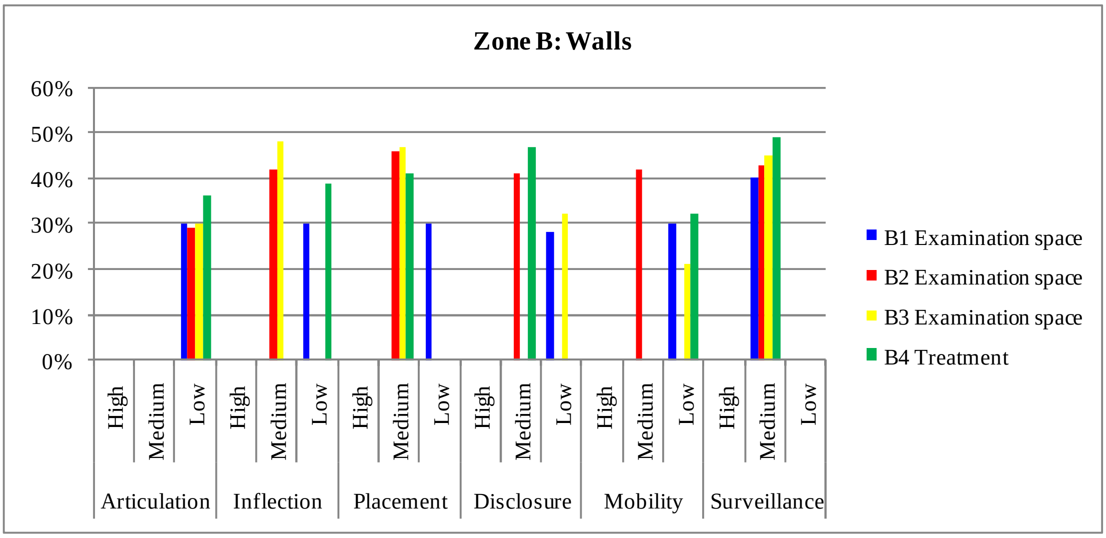




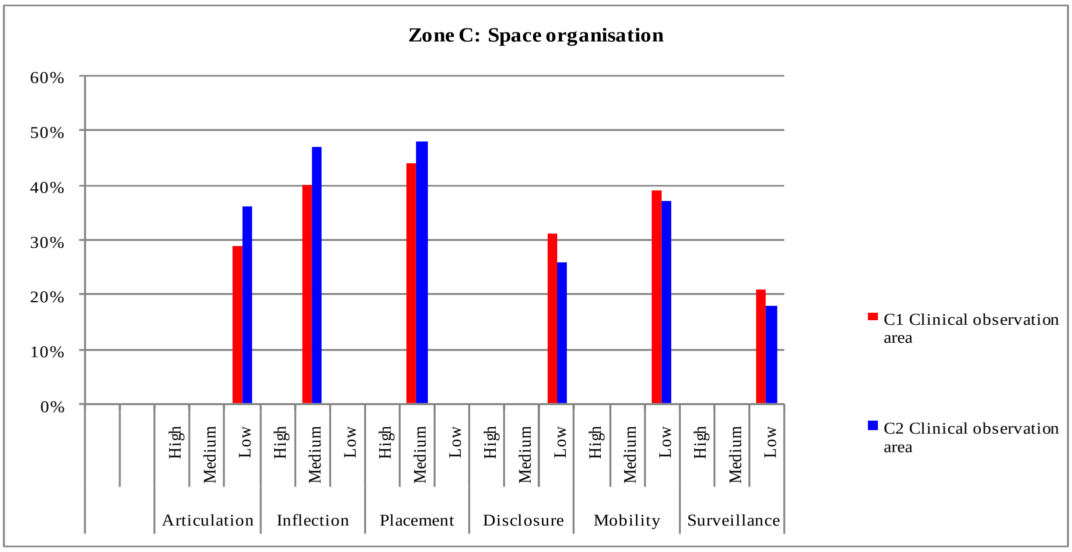
Appendix Q: Results of the PAH accident and emergency facility floor plan analysis

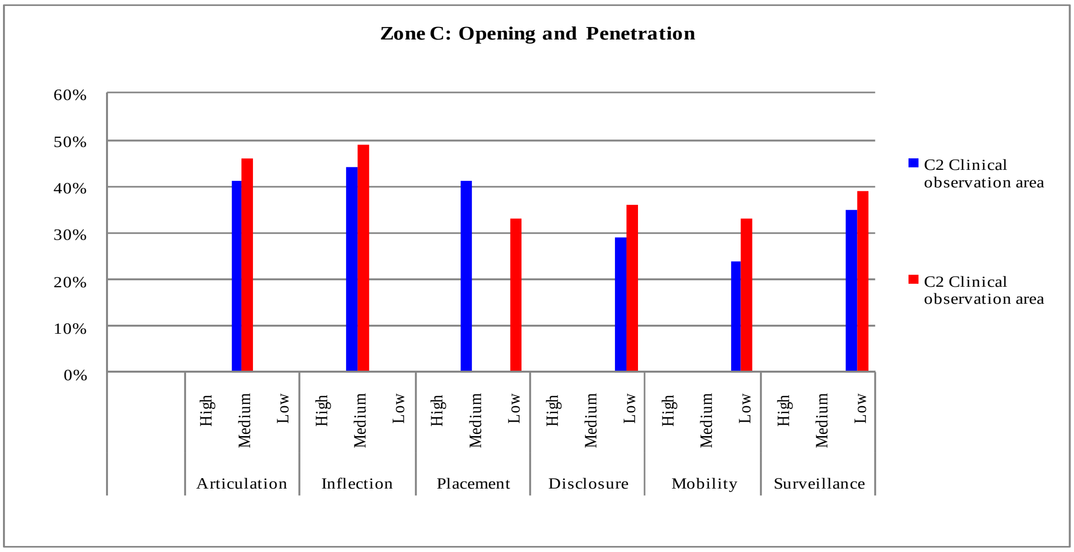


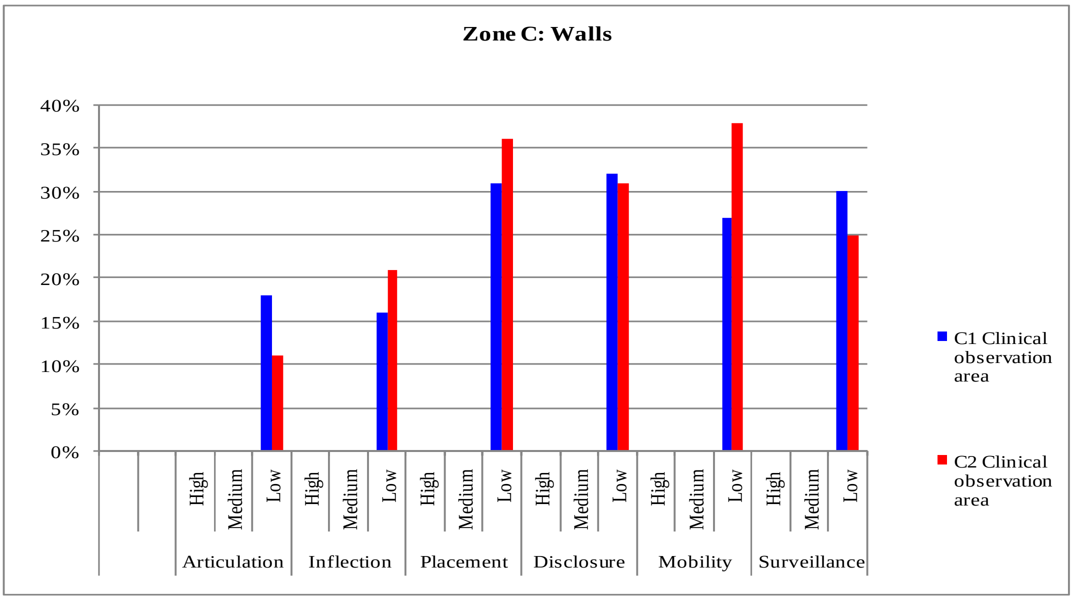




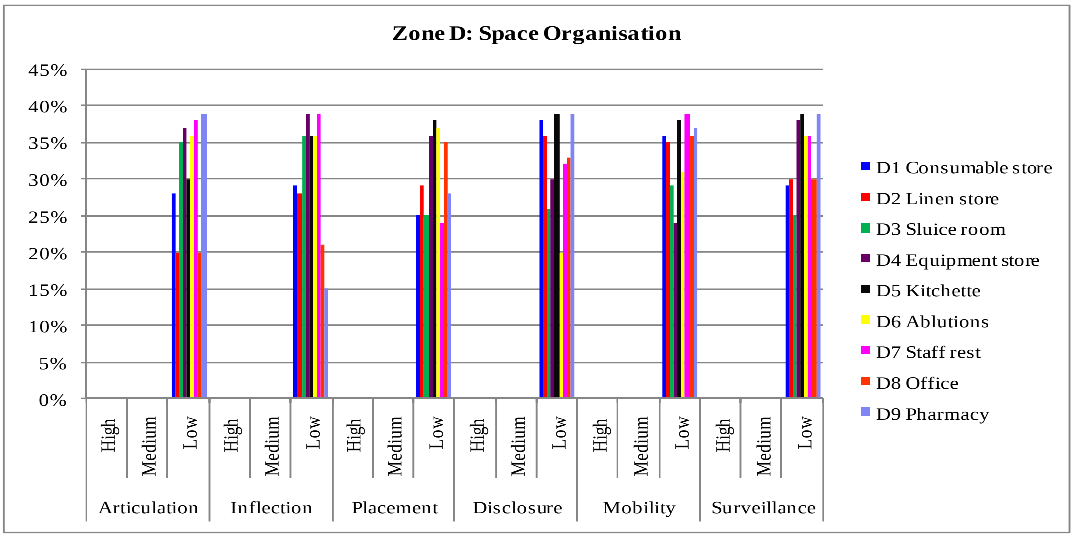
Appendix Q: Results of the PAH accident and emergency facility floor plan analysis

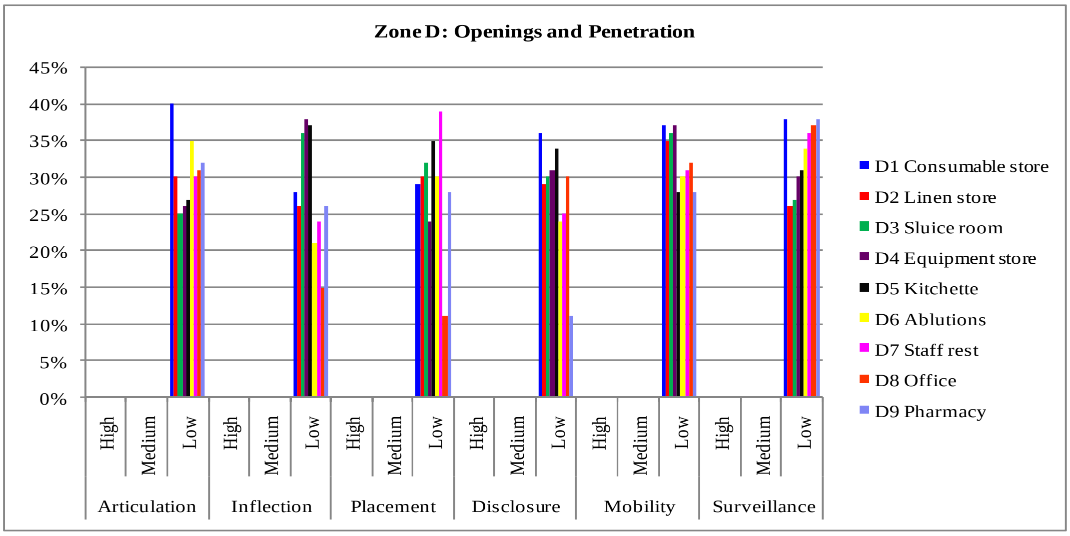


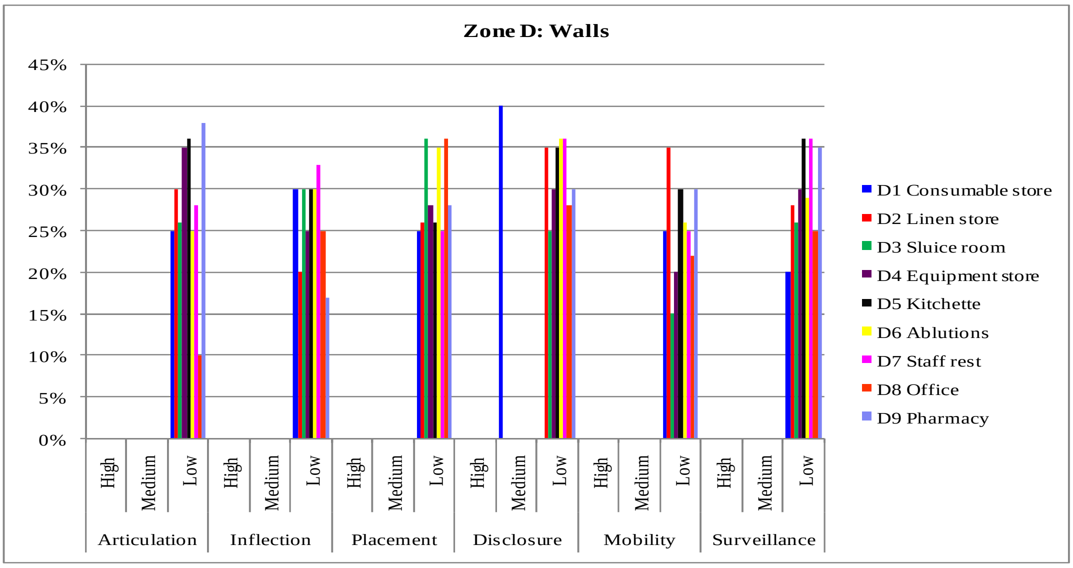




Appendix Q: Results of the PAH accident and emergency facility floor plan analysis







Appendix R: Results of the observational studies at CHBH

Functional Suitability - Number of visits to support and ancillary areas by caregivers

CHBH A & E FACILITY SOWETO, JOHANNESBURG

No.	SN/B	50		Participant observation: the role of design guidelines for Accident and Emergency Facilities (A&E) in South Africa

Department: CHBH A& E	Date: Jan. 2008

Result Codes	01	Complete	√	02	Partly Complete	

Duration of Fieldwork	Start	21 Jan.	Finish	25 Jan.	Total	5 Days

In which zone of the department: A, B, C and D? ………Zone D

Functional Suitability

Number visits to support and ancillary areas by caregivers

Caregivers Daily Work Shift		Number of visits					
		Consumable store	**Equip. store**	**Sluice room**	**Kitchenette**	**Ablution**	**Staff area**
Day 1	6.am to 9.am	3	2	3	2	7	2
	9.30am to12.30pm	4	3	5	5	3	3
	1.pm to 4.pm	6	4	5	3	1	1
	Total	**13**	**9**	**13**	**10**	**11**	**6**
Day 2	6.am to 9.am	4	3	3	1	1	3
	9.30am to12.30pm	2	3	4	1	2	4
	1.pm to 4.pm	3	2	4	3	1	1
	Total	**9**	**8**	**11**	**5**	**4**	**8**
Day 3	6.am to 9.am	3	3	2	3	2	3
	9.30am to12.30pm	4	3	4	7	2	1
	1.pm to 4.pm	1	2	3	4	2	2
	Total	**8**	**8**	**9**	**13**	**6**	**6**
Day 4	6.am to 9.am	4	2	2	4	3	2
	9.30am to12.30pm	3	1	5	2	2	3
	1.pm to 4.pm	2	3	1	3	1	1
	Total	**9**	**5**	**8**	**9**	**6**	**6**
Day 5	6.am to 9.am	4	2	3	3	1	2
	9.30am to12.30pm	5	4	5	2	4	5
	1.pm to 4.pm	4	3	3	3	1	4
	Total	**13**	**9**	**11**	**8**	**6**	**11**

Appendix R: Results of the observational studies: Functional Suitability – Space use occupancy

CHBH A & E FACILITY SOWETO, JOHANNESBURG

No.	SN/B	50		Participant observation: the role of design guidelines for Accident and Emergency Facilities (A&E) in South Africa

Department: CHBH A & E	Date: Jan. 2008

Result Codes	01	Complete	√	02	Partly Complete	

Duration of Fieldwork	Start	21 Jan.	Finish	25 Jan.	Total	5 Days

In which zone of the department: A, B, C and D? …………………Zone B

Functional suitability

Space use occupancy			
Caregivers daily work shift		**Room type Examination/Treatment**	**Total time in room**
Day 1	6.00 am to 9.am	R 1	30 minutes
		R 2	1.hrs
		R 3	45 minutes
	9.30am to 12.30pm	R 1	56 minutes
		R 2	1.30 hrs
		R 3	2.00 hrs
	1.00 pm to 4.pm	R 1	45 minutes
		R 2	38 minutes
		R 3	2.00 hrs
Day 2	6.00 am to 9.am	R 1	1.00 hrs
		R 2	55 minutes
		R 3	48 minutes
	9.30am to 12.30pm	R 1	56 minutes
		R 2	48 minutes
		R 3	1.35 hrs
	1.00 pm to 4.pm	R 1	1.22 hrs
		R 2	1.05 hrs
		R 3	1.56 hrs

Appendix R: Results of the observational studies in Zone B: Average turnaround time in examination and treatment rooms

CHBH A & E FACILITY SOWETO, JOHANNESBURG

No.	SN/B	50		Participant observation: the role of design guidelines for Accident and Emergency Facilities (A&E) in South Africa

Department: CHBH A & E	Date: Jan. 2008

Result Codes	01	Complete	√	02	Partly Complete	

Duration of Fieldwork	Start	07 Jan.	Finish	11 Jan.	Total	5 Days

In which zone of the department: A, B, C and D? …………………Zone B

Functional suitability

Average turnaround time in examination and treatment rooms					
Days	**Week 1**		**Time patient entered exam/treatment room**	**Time patient left exam/treatment room(am/pm)**	**Total time**
D1	P1	6.am to 9.am	6.30 am	7.30 am	1 hr
		9.30am to 12.30pm	9.40 am	11.00am	1.20 hrs
		1.pm to 4.pm	1.10.pm	2.10pm	1. hrs
D2	P2	6.am to 9.am	7.am	8.30am	1.30hrs
		9.30am to 12.30pm	9.30 am	11.10am	1.40.hrs
		1.pm to 4.pm	1.10 pm	2.10pm	1.hrs
D3	P3	6.am to 9.am	6.30am	7.30am	1.hrs
		9.30am to 12.30pm	9.30am	11.am	1.30hrs
		1.pm to 4.pm	1.15pm	2.pm	45.mnts
D4	P4	6.am to 9.am	6.30am	7.35am	1.05.hrs
		9.30am to 12.30pm	10.am	11.30am	1.30hrs
		1.pm to 4.pm	1.pm	2.pm	1.hrs
D5	P5	6.am to 9.am	6.30am	7.am	30.mnts
		9.30am to 12.30pm	9.50am	11.am	1.10hrs
		1.pm to 4.pm	1.55pm	2.50pm	55.mnts

Appendix R: Results of the observational studies in CHBH Zone A: Interior ambience

CHBH A & E FACILITY SOWETO, JOHANNESBURG

No.	SN/B	50		Participant observation: the role of design guidelines for Accident and Emergency Facilities (A&E) in South Africa

Department: CHBH A& E	Date: Jan. 2008

Result Codes	01	Complete	√	02	Partly Complete	

Duration of Fieldwork	Start	07 Jan.	Finish	11Jan.	Total	5 Days

In which zone of the department: A, B, C and D? Zone A

Interior ambience

Interior ambience		**Zone A**					
		A 1	**A 2**	**A 3**	**A 4**	**A 5**	**A 6**
Spatial modulation	High						
	Medium						
	Low	38%	35%	32%	36%	21%	39%
Spatial texture	High						
	Medium						
	Low	29%	25%	38%	19%	35%	19%
Use of pattern	High						
	Medium						
	Low	36%	31%	28%	33%	39%	31%

The scores are ranked as follows:

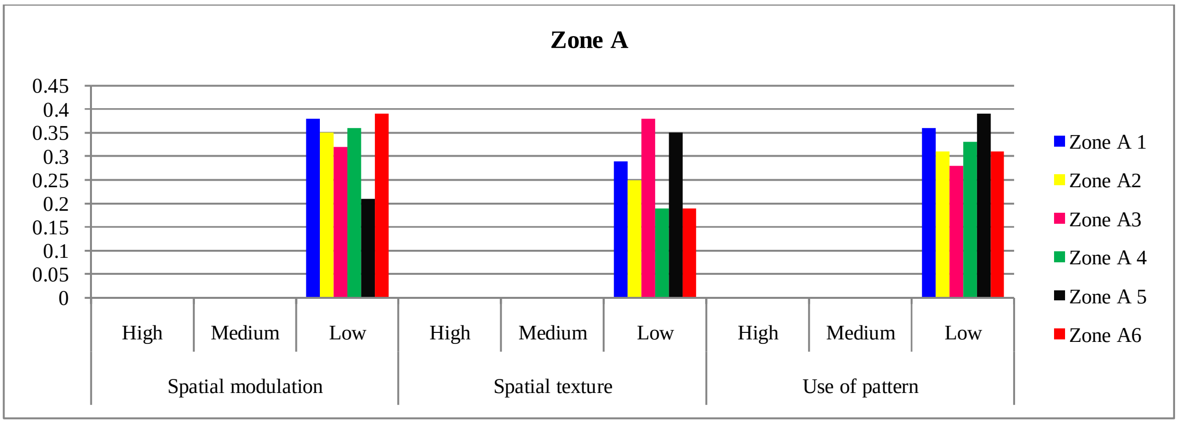
High = 50% and Above: Medium = 40% - 50%

Low = Below 40%

Legend

A1 Entrance 1: A2 Entrance 2: A3 Reception

A4 Waiting 1: A5 Waiting 2 A6 Triage/Pre-Examination



Appendix R: Results of the observational studies in CHBH Zone B: Interior ambience

CHBH A & E FACILITY SOWETO, JOHANNESBURG

No.	SN/B	50		Participant observation: the role of design guidelines for Accident and Emergency Facilities (A&E) in South Africa

Department: CHBH A & E	Date: June 2007

Result Codes	01	Complete	√	02	Partly Complete	

Duration of Fieldwork	Start	06 Jun	Finish	10 Jun	Total	5 Days

In which zone of the department: A, B, C and D? Zone B

Interior ambience

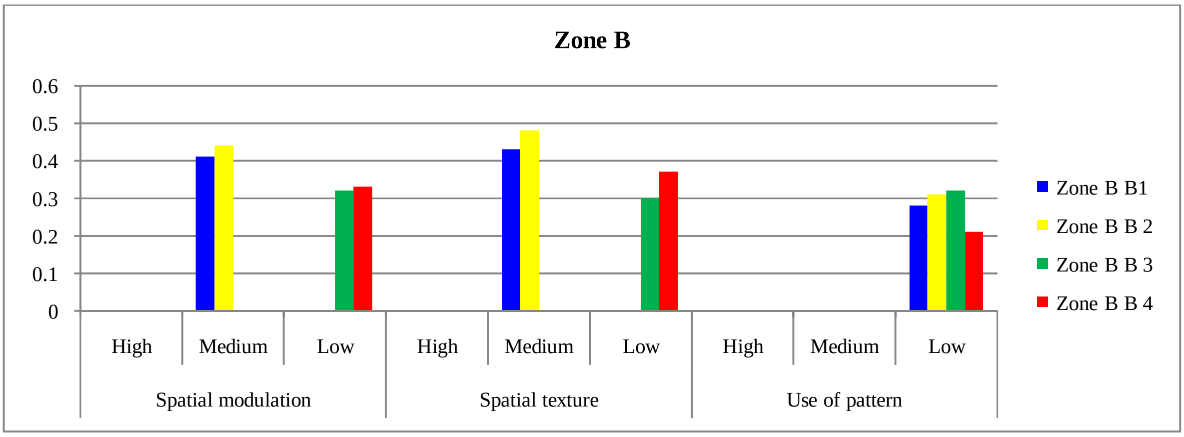
Interior ambience		**Zone B**			
		B1	**B 2**	**B 3**	**B 4**
Spatial modulation	High				
	Medium	41%	44%		
	Low			32%	33%
Spatial texture	High				
	Medium	43%	48%		
	Low			30%	37%
Use of pattern	High				
	Medium				
	Low	28%	31%	32%	21%

The scores are ranked as follows:

High= 50% and Above
Medium = 40% - 50%
Low = Below 40%

Legend

B1, B2, B3, and B4 Examination and Treatment Rooms



Appendix S: Results of the observational studies at PAH Zone A: Interior ambience

PAH A & E FACILITY, PRETORIA

No.	SN/B	50		Participant observation: the role of design guidelines for Accident and Emergency Facilities (A&E) in South Africa

Department: PAH A& E	Date: Feb. 2008

Result Codes	01	Complete	√	02	Partly Complete	

Duration of Fieldwork	Start	18 Feb.	Finish	22 Feb.	Total	5 Days

In which zone of the department: A, B, C and D? Zone A

Interior ambience

Interior ambience		**Zone**					
		A 1	**A 2**	**A 3**	**A 4**	**A5**	**A 6**
Spatial modulation	High						
	Medium	42%	47%				
	Low			32%	36%	21%	39%
Spatial texture	High						
	Medium						
	Low	37%	33%	39%	28%	22%	31%
Use of pattern	High						
	Medium						
	Low	32%	25%	34%	39%	19%	37%

The scores are ranked as follows:

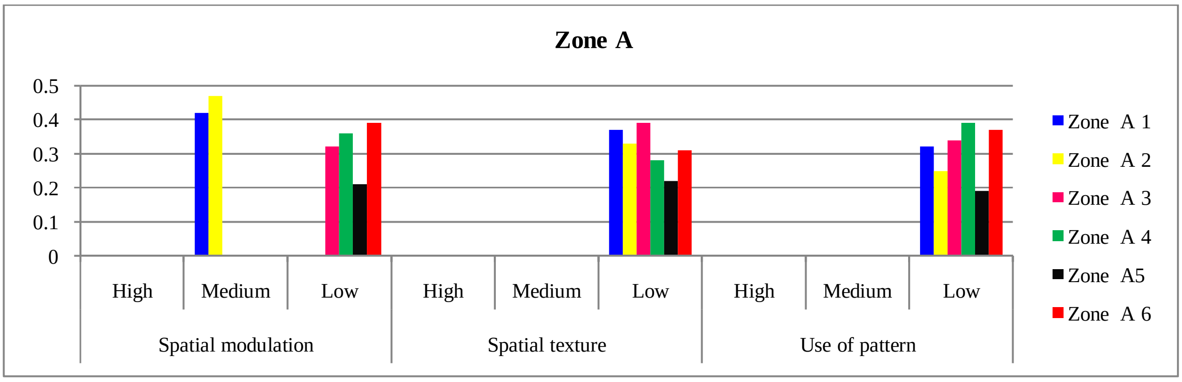
High = 50% and Above   Medium = 40% - 50%

Low = Below 40%

:

Legend

A1 Entrance1: A2 Entrance 2: A3 Reception: A4 Waiting: A5 Triage/Pre-Examination



Appendix S: Results of the observational studies in PAH Zone B: Interior ambience

PAH A & E FACILITY, PRETORIA

No.	SN/B	50		Participant observation: the role of design guidelines for Accident and Emergency Facilities (A&E) in South Africa

Department: PAH A & E	Date: Feb. 2008

Result Codes	01	Complete	√	02	Partly Complete	

Duration of Fieldwork	Start	18 Feb.	Finish	22 Feb.	Total	5 Days

In which zone of the department: A, B, C and D? Zone B

Spatial Relationships

Interior ambience		Zone B1	Zone B2	Zone B3	Zone B4
Spatial modulation	High				
	Medium	42%	46%		
	Low			35%	34%
Spatial texture	High				
	Medium				
	Low	34%	39%	27%	38%
Use of pattern	High				
	Medium				
	Low	18%	28%	31%	39%

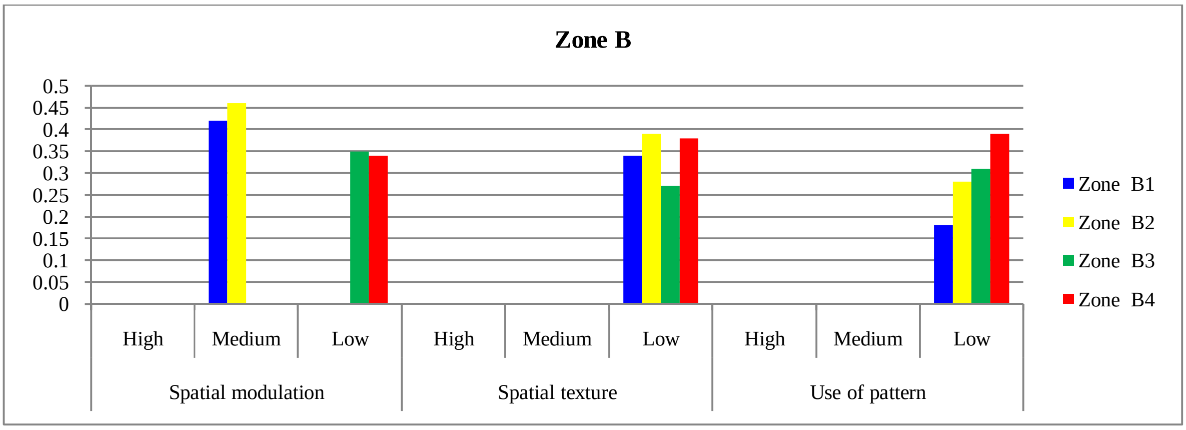
The scores are ranked as follows:

High = 50% and Above
Medium = 40% - 50%
Low = Below 40%

Legend

B1 Examination/Treatment: B2 Examination/Treatment:

B3 Examination/Treatment: B4 Examination/Treatment:



Appendix S: Results of the observational studies in PAH Zone C: Interior ambience

PAH A & E FACILITY, PRETORIA

No.	SN/B	50		Participant observation: the role of design guidelines for Accident and Emergency Facilities (A&E) in South Africa

Department: PAH A & E	Date: Feb. 2008

Result Codes	01	Complete	√	02	Partly Complete	

Duration of Fieldwork	Start	18 Feb.	Finish	22 Feb.	Total	5 Days

In which zone of the department: A, B, C and D? Zone C

Interior ambience

Interior ambience		**Zone C 1**	**Zone C 2**	**Zone C 3**
Spatial modulation	High			
	Medium	46%	49%	42%
	Low			
Spatial texture	High			
	Medium	47%		
	Low		28%	38%
Use of pattern	High			
	Medium			
	Low	38%	35%	31%

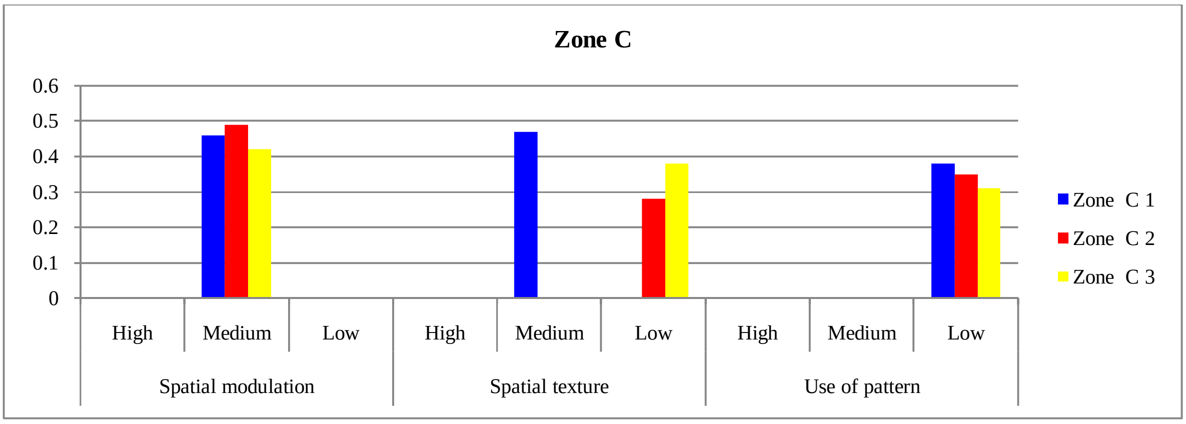
The scores are ranked as follows:

High = 50% and Above
Medium = 40% - 50%
Low = Below 40%

Legend

C1 Clinical observation area

C2 Clinical observation area



Appendix S: Results of the observational studies in Zone D: Interior ambience

PAH A & E FACILITY, PRETORIA

No.	SN/B	50		Participant observation: the role of design guidelines for Accident and Emergency Facilities (A&E) in South Africa

Department: PAH A& E	Date: Feb. 2008

Result Codes	01	Complete	√	02	Partly Complete	
Duration of Fieldwork	Start	18 Feb.	Finish	22 Feb.	Total	5 Days

Interior ambience

Interior ambience		**Zone D 1**	**D 2**	**D 3**	**D4**	**D5**
Spatial modulation	High					
	Medium					
	Low	18%	38%	36%	30%	39%
Spatial texture	High					
	Medium					
	Low	23%	31%	37%	29%	34%
Use of pattern	High					
	Medium					
	Low	25%	36%	25%	17%	30%

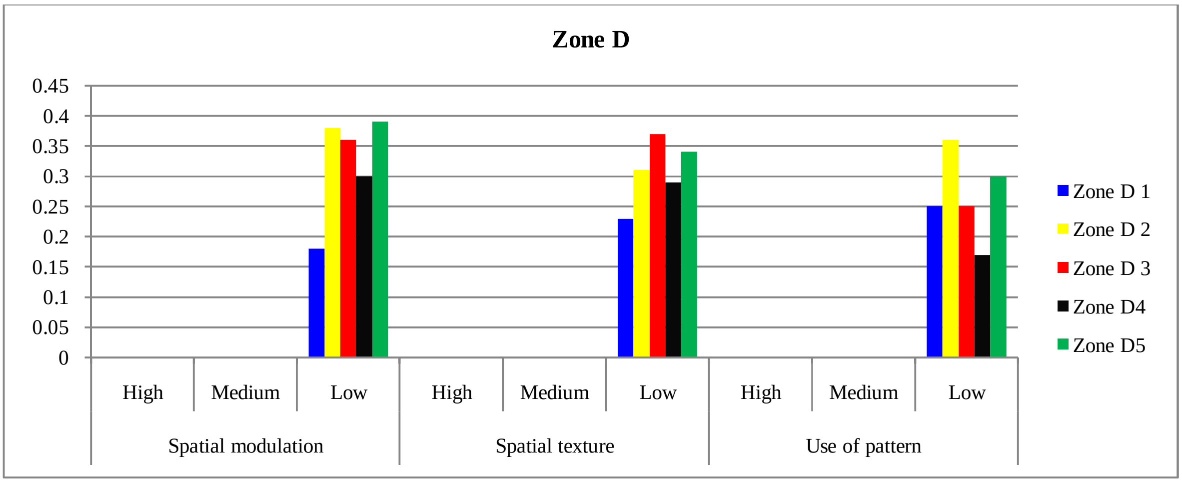
The scores are ranked as follows:

High = 50% and Above
Medium = 40% - 50%
Low = Below 40%

Legend

D1 Consumable store: D2 Linen store: D3 Sluice room:

D4 Equipment store: D5 Kitchenette:



Appendix T: Research Clearance Certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)
R14/49/1 Okpanum

CLEARANCE CERTIFICATE	PROTOCOL NUMBER H070906
PROJECT	Field research to contribute to an understanding of the role that hospital architecture design norms can play in contributing positively to the overall quality of health care delivery to the public
INVESTIGATORS	Ms I Okpanum
DEPARTMENT	Social Surveys Africa/Architecture
DATE CONSIDERED	07.09.14
DECISION OF THE COMMITTEE*	Approved Unconditionally

NOTE:

This ethical clearance is valid for 2 years and may be renewed upon application

DATE 08.01.09 pp CHAIRPERSON ....
(Professor M Vorster)

cc: Supervisor :

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University.

I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

Signature

This ethical clearance is valid for two years from date of approval.

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES